Resources Model Layer

2. IfcActorResource

The IfcActorResource schema defines the properties of persons and organizations whose services may be used within a project.

NOTE: New schema for R2.0. This schema was formerly part of the IfcPropertyResource schema.

2.1. Select IfcActorSelect

2.1.1. Select Semantic Definition

The actor select type allows a person and/or organization to be referenced.

2.1.2. Select

IfcOrganization
IfcPerson
IfcPersonAndOrganization

2.2. Type IfcRoleEnum

2.2.1. Type Semantic Definition

Roles which may be played by an actor.

2.2.2. Enumeration

Supplier
Manufacturer
Contractor
SubContractor
Architect
StructuralEngineer
ServicesEngineer
CostEngineer
Client
BuildingOwner
BuildingOperator
UserDefined
NotDefined

2.3. Class IfcActorRole

2.3.1. Class Semantic Definition

A role which is performed by an actor, either a person, an organization or a person and organization.

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

2.3.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Role	The name of the role played by an actor.	IfcRoleEnum	Supplier	Other	Other
OPT	Description	A textual description relating the nature of the role played by an actor.	STRING	empty string	n/a	NIL

2.3.3. Interface Definitions

- I_ActorRole

2.3.4. Geometry Use Definitions

Instances of this class have no physical presence and therefore no geometric representation.

2.4. Class IfcAddress

2.4.1. Class Semantic Definition

The place at which people and organizations are normally located.

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

2.4.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
OPT	InternalLocation	An organization defined address for internal mail delivery.	STRING	empty string	n/a	NIL
	AddressLines	The postal address of the person or	LIST [0:?] OF STRING	n/a	n/a	empty list

		organization. NOTE - A postal address may occupy several lines when recorded. It is expected that normal usage will incorporate relevant elements of the following address concepts:- A location within a building (e.g. 3rd Floor) Building name (e.g. Interoperability House) Street number (e.g. 6400) Street name (e.g. Alliance Boulevard)				
OPT	Town	The name of a town.	STRING	empty string	n/a	NIL
OPT	Region	The name of a region. NOTE - The counties of the United Kingdom and the states of North America are examples of regions.	STRING	empty string	n/a	NIL
OPT	PostalCode	The code that is used by the country's postal service.	STRING	empty string	n/a	NIL
OPT	Country	The name of a country.	STRING	empty string	n/a	NIL
	FacsimileNumbers		LIST [0:?] OF STRING			
	TelephoneNumbers		LIST [0:?] OF STRING			
	ElectronicMailAddresses		LIST [0:?] OF STRING			
OPT	TelexNumber	The telex number at which telex messages may be received.	STRING	empty string	n/a	NIL
OPT	WWWHomePageURL	The world wide web address at which the preliminary page of information for the person or organization can be located. NOTE - Information on the world wide web for a person or organization may be separated into a number of pages and across a number of host sites, all of which may be linked together. It is assumed that all such information may be referenced from a single page that is termed the home page for that person or organization.	STRING	empty string	n/a	NIL
OPT	Description	Text that relates the nature of the address.	STRING	empty string	n/a	NIL
OPT	PostalBox	An address that is implied by an identifiable mail drop.	STRING	empty string	n/a	NIL
INV	OfPerson	Person to whom address is associated	SET [0:?] OF IfcPerson	n/a	n/a	empty list
INV	OfOrganization	Organization to whom address is associated	SET [0:?] OF IfcOrganization	n/a	n/a	empty list

Formal Propositions

WR1	At least one of the following has to be given: InternalLocation OR AddressLines OR Town OR Region OR PostalCode OR Country OR FacsimileNumbers OR TelephoneNumbers OR ElectronicMailAddresses OR TelexNumber OR WWWHomePage

2.4.3. Interface Definitions

- I_Address

2.4.4. Geometry Use Definitions

Instances of this class have no physical presence and therefore no geometric representation.

2.5. Class IfcOrganization

2.5.1. Class Semantic Definition

A named and structured grouping with a corporate identity.

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

2.5.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Name	The word, or group of words, by which the organization is referred to.	STRING	empty string	n/a	n/a
	Addresses	Place or places at which an organization may be located. NOTE - An organization may be located at several addresses.	LIST [0:?] OF IfcAddress	n/a	n/a	empty list
	Roles	Roles played by the organization.	LIST [0:?] OF IfcActorRole	n/a	n/a	empty list
OPT	Description	Text that relates the nature of the organization.	STRING	empty string	see type	NIL

2.5.3. Interface Definitions

- I_Organization

2.5.4. Geometry Use Definitions

Instances of this class have no physical presence and therefore no geometric representation.

2.6. Class IfcPerson

2.6.1. Class Semantic Definition

An individual human being.

NOTE:

In order to comply with legal requirements in various places (such as the Data Protection Act of the United Kingdom), this class only allows for identification of a person by name.

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

2.6.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
OPT	FamilyName	The name by which the family identity of the person may be recognized. NOTE - Depending on geographical location and culture, family name may appear either as the first or last component of a name.	STRING	empty string	n/a	NIL
OPT	GivenName	The name by which a person is known within a family and by which he or she may be familiarly recognized. NOTE - Depending on geographical location and culture, given name may appear either as the first or last component of a name.	STRING	empty string	n/a	NIL
OPT	MiddleNames	Additional names given to a person that enable their identification apart from others who may have the same or similar family and given names.	STRING	empty string	n/a	NIL
OPT	PrefixTitles	The word, or group of words, which specify the person's social and/or professional standing and appear before his/her names.	STRING	empty string	n/a	NIL
OPT	SuffixTitles	The word, or group of words, which specify the person's social and/or professional standing and appear after his/her names.	STRING	empty string	n/a	NIL
	Addresses	Place or places at which a person may be located. NOTE - A person may be located at several addresses.	LIST [0:?] OF IfcAddress	n/a	n/a	empty list
	Roles	Roles played by the person.	LIST [0:?] OF IfcActorRole	n/a	n/a	empty list

Formal Propositions

WR1	Either FamilyName or GivenName has to be given

2.6.3. Interface Definitions

- I_Person

2.6.4. Geometry Use Definitions

Instances of this class have no physical presence and therefore no geometric representation.

2.7. Class IfcPersonAndOrganization

2.7.1. Class Semantic Definition

Identification of a person within an organization.

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

2.7.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	ThePerson	The person who is related to the organization.	IfcPerson	see type	see type	n/a
	TheOrganization	The organization to which the person is related.	IfcOrganization	see type	see type	n/a
	Roles	Roles played by the person and organization.	LIST [0:?] OF IfcActorRole	see type	see type	empty list

2.7.3. Interface Definitions

- I_PersonAndOrganization

2.7.4. Geometry Use Definitions

Instances of this class have no physical presence and therefore no geometric representation.

3. IfcClassificationResource

The IfcClassificationResource schema defines the assignment of classification(s) to objects.

NOTE: New schema for R2.0. This schema was formerly part of the IfcPropertyResource schema.

3.1. Class IfcClassification

3.1.1. Class Semantic Definition

Used for the arrangement of objects into a class or category according to a common purpose or their possession of common characteristics.

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

3.1.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Source	Source (or publisher) for this reference classification.	STRING	see type	see type	n/a
OPT	Table	Table from published reference.	STRING	see type	see type	NIL
	Notation	Notation used from published reference.	IfcClassificationNotation	see type	see type	n/a
	Description	Description of this published reference.	STRING	see type	see type	n/a
OPT	Edition	The edition or version of the classification system from which the classification is derived.	STRING	see type	see type	NIL

3.1.3. Interface Definitions

- I_Classification

3.1.4. Geometry Use Definitions

Instances of this class have no physical presence and therefore no geometric representation.

3.2. Class IfcClassificationList

3.2.1. Class Semantic Definition

Data structure used to classify an element according to multiple classification systems.

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

3.2.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Classifications	Published classifications referenced.	LIST [1:?] OF IfcClassification	n/a	n/a	n/a
	Priority	Priority index into list of classifications.	INTEGER	see type	see type	1

3.2.3. Interface Definitions

- I_ClassificationList

3.2.4. Geometry Use Definitions

Instances of this class have no physical presence and therefore no geometric representation.

3.3. Class IfcClassificationNotation

3.3.1. Class Semantic Definition

Notation used from published reference.

NOTE: A classification notation may be developed using various classification facets. A facet is a part of the actual notation but which has a specific meaning. For instance, it may be appropriate to classify an item by owning discipline (actor) and by an entry from a classification table such as CI/SfB. In this case, an external wall might be classified as:

A210 or (using a separator character) A:210

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

3.3.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	NotationFacets	Alphanumeric characters in defined groups from which the classification notation is derived.	LIST [1:?] OF IfcNotationFacet	n/a	n/a	n/a

3.3.3. Interface Definitions

- I_ClassificationNotation

3.3.4. Geometry Use Definitions

Instances of this class have no physical presence and therefore no geometric representation.

3.4. Class IfcNotationFacet

3.4.1. Class Semantic Definition

A group of alphanumeric characters used within a classification notation.

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

3.4.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	NotationValue	The actual alphanumeric character group forming the notation STRING.	STRING	see type	see type	n/a
OPT	Purpose	The purpose of the notation STRING.	STRING	see type	see type	NIL

3.4.3. Interface Definitions

- I_NotationFacet

3.4.4. Geometry Use Definitions

Instances of this class have no physical presence and therefore no geometric representation.

4. IfcCostResource

The IfcCostResource schema provides the means to identify the cost of an object or aggregation of objects.

NOTE: New schema for R2.0. This schema was formerly part of the IfcPropertyResource schema.

4.1. Type IfcCostEnum

4.1.1. Type Semantic Definition

4.1.2. Enumeration

LaborCost	The cost of human resources.
PlantCost	The cost for items of equipment rented or purchased for use on this project but which will not be embodied within the final product.
MaterialCost	The cost of materials purchased (or sold)
SubContractCost	A cost for work that is done by a third party under contract.
PreliminariesCost	Costs that describe work associated with a project but which do not form part of the completed product e.g. temporary construction works.
PrimeCost	A cost which is an amount to be included for work or services to be executed by a nominated actor.
BillOfMaterialsCost	A composite cost which is to be included within a formal bill of materials.
ProvisionalCost	A cost that is included for work that is foreseen but cannot be accurately specified at the time of costing.
OverheadCost	A cost that is included to account for administrative and non-productive work.
ProfitCost	A cost that is the difference between the selling price and the buying price of an artefact.

4.2. Type IfcCostOperatorEnum

4.2.1. Type Semantic Definition

A mathematical operator which determines how the cost modifier is to be applied to the cost to vary its value.

NOTE: Cost operators are specified as being by value or by percent.

If the operator is by value (add, subtract or multiply), this means that cost modifiers are applied directly according to the value attribute of the modifier. That is, for a selection of 'AddValue' with a value attribute of 20 on a cost of $120, the modified value would be determined by $120 + $20 = $140.

If the operator is by percent(add, subtract or multiply), this means that cost modifiers are applied by transforming the value attribute from a percentage to an actual value . That is, for a selection of 'AddPercent' with a value attribute of 20 on a cost of $120, the modified value would be determined by $120 + $(120 * 20/100) = $144.

4.2.2. Enumeration

AddValue
SubstractValue
MultiplyValue
AddPercent
SubstractPercent
MultiplyPercent

4.3. Type IfcModifierBasisEnum

4.3.1. Type Semantic Definition

The manner in which cost modifiers are applied to a cost.

NOTE: Cost modifiers may be applied to costs based either on the initial value of the cost or on the running total of cost after the application of a previous modifier. This attribute sets the basis upon which modifiers are applied.

Note that modifiers can only be applied on a single basis; it is not possible to mix the application of running and static modifiers to a single cost.

4.3.2. Enumeration

Running
Static

4.4. Class IfcCost

4.4.1. Class Semantic Definition

Amount to be paid for acquisition, installation, or assembly; associated with a product, process, or resource.

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

4.4.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	CostType	Type of Cost specified.	IfcCostEnum	LaborCost	ProvisionalCost	LaborCost
OPT	BaseCostValue	Amount of this cost before the application of cost modifiers.	IfcMonetaryMeasure	n/a	n/a	NIL
OPT	FinalCostValue	Amount of this cost following the application of cost modifiers.	IfcMonetaryMeasure	n/a	n/a	NIL
	Currency	Currency for this cost amount. NOTE - Currencies are defined by standard three character designations as used by banks and financial institutions.	IfcCurrencyEnum	AED	ZWD	USD
OPT	ModifierBasis	The manner in which cost modifiers are applied to a cost. NOTE - Where cost modifiers are specified, the modifier basis must be asserted.	IfcModifierBasisEnum	Running	Static	NIL
	ModifierValues	Modifiers which may be applied to a cost to change its value.	LIST [0:?] OF IfcCostModifier	n/a	n/a	empty list
	UnitCostBasis	The number and unit of measure on which the unit cost is based. NOTE - As well as the normally expected units of measure such as length, area, volume etc., costs may be based on units of measure which need to be defined e.g. sack, drum, pallet etc. Unit costs may be based on quantities greater (or lesser) than a unitary value of the basis measure. For instance, timber may have a unit cost rate per X meters where X 1; similarly for cable, piping and many other items. The basis number may be either an integer or a real value.	IfcMeasureWithUnit	n/a	n/a	n/a
OPT	CostDate	The date at which the cost is applied.	IfcDateTimeSelect	n/a	n/a	NIL
	CostComponents	Costs that are components of another cost and from which that cost may be deduced. NOTE - Allows an estimator to roll up components (estimates or bids) into composite costs for assemblies.	LIST [0:?] OF IfcCost	n/a	n/a	empty list
INV	ComponentOf		SET [0:?] OF IfcCost			

4.4.3. Interface Definitions

- I_Cost

4.4.4. Geometry Use Definitions

Instances of this class have no physical presence and therefore no geometric representation.

4.5. Class IfcCostModifier

4.5.1. Class Semantic Definition

Modifier which influences a cost.

NOTE: A cost modifier is given either as a value or as a percentage and is applied using the specified cost operator designation which indicates the action of the operator.

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

4.5.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Purpose	The purpose for which a cost modifier is applied. NOTE - Each cost modifier may be assigned a purpose by which it may be recognized. Purposes might include trade discount, quantity discount, bulk purchase rebate, postage and packing cost, abnormal working conditions factor etc.	STRING	empty string	n/a	n/a
	CostValue	The value assigned to a cost factor.	REAL	0	n/a	1
	CostOperator	A mathematical operator that determines how the cost modifier is to be applied to the cost to vary its value.	IfcCostOperatorEnum	AddValue	MultiplyPercent	AddValue

4.5.3. Interface Definitions

- I_CostModifier

4.5.4. Geometry Use Definitions

Instances of this class have no physical presence and therefore no geometric representation.

5. IfcDateTimeResource

The IfcDateTimeResource schema defines dates and times that may be applied. The date and times include specifying a calendar date, a local time with possible daylight saving offset compared to solar time, the local time offset to coordinated universal time, and complete specification of combined date and time.

NOTE: New schema for R2.0. This schema was formerly part of the IfcPropertyResource schema that is now superseded.
Parts of this schema are © ISO.

5.1. Type IfcDayInMonthNumber

5.1.1. Type Semantic Definition

An integer value of the day within a month.

History

This Defined Type has changed after IFC Release 1.5.1, please see the Migration Guide for details

5.1.2. Type

INTEGER

5.2. Type IfcDaylightSavingNumber

5.2.1. Type Semantic Definition

The positive integer value by which clock time is offset from solar time at the particular location.

History

This Defined Type has changed after IFC Release 1.5.1, please see the Migration Guide for details

5.2.2. Type

INTEGER

Formal Propositions

WR1	Daylight saving number is always positive and can take the maximum value of 2 (hours) ahead of local time. Depending on the locality and the time of year, the value may be 0, 1 or 2.

5.3. Type IfcHourInDay

5.3.1. Type Semantic Definition

An integer value of the hour within a day.

History

This Defined Type has changed after IFC Release 1.5.1, please see the Migration Guide for details

5.3.2. Type

INTEGER

Formal Propositions

WR1	Although there are 24 hours in a day, hour designations are always from 0 to 23 (since hour 24 is the same as hour 0)

5.4. Type IfcMinuteInHour

5.4.1. Type Semantic Definition

An integer value of the minute within an hour.

History

This Defined Type has changed after IFC Release 1.5.1, please see the Migration Guide for details

5.4.2. Type

INTEGER

Formal Propositions

WR1	Although there are 60 minutes in an hour, minute designations are always from 0 to 59 (since minute 60 is the same as minute 0)

5.5. Type IfcMonthInYearNumber

5.5.1. Type Semantic Definition

An integer value of the month within a year.

History

This Defined Type has changed after IFC Release 1.5.1, please see the Migration Guide for details

5.5.2. Type

INTEGER

Formal Propositions

WR1	Months in a year are numbered from 1 to 12.

5.6. Type IfcSecondInMinute

5.6.1. Type Semantic Definition

A real number value of the second in a minute. Thus, decimals of a second are allowed.

History

This Defined Type has changed after IFC Release 1.5.1, please see the Migration Guide for details

5.6.2. Type

REAL

Formal Propositions

WR1	Although there are 60 seconds in a minute, second designations are always from 0 to 59 (since second 60 is the same as second 0)

5.7. Type IfcYearNumber

5.7.1. Type Semantic Definition

Is the year in Gregorian calendar as defined by ISO 8601.

History

This Defined Type has changed after IFC Release 1.5.1, please see the Migration Guide for details

5.7.2. Type

INTEGER

5.8. Select IfcDateTimeSelect

5.8.1. Select Semantic Definition

5.8.2. Select

IfcCalendarDate
IfcLocalTime
IfcDateAndTime

5.9. Type IfcAheadOrBehind

5.9.1. Type Semantic Definition

An enumeration type that is used to specify whether a local time is ahead or behind of the coordinated universal time. IfcAheadOrBehind can take values Ahead or Behind.

History

New Enumeration in IFC Release 2.0

5.9.2. Enumeration

Ahead
Behind

5.10. Class IfcCalendarDate

5.10.1. Class Semantic Definition

The date of interest expressed by the day in a month of a year.

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

5.10.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	DayComponent	The day component of the calendar date.	IfcDayInMonthNumber	see type	see type	n/a
	MonthComponent	The month component of the calendar date.	IfcMonthInYearNumber	see type	see type	n/a
	YearComponent	The year component of the calendar date.	IfcYearNumber	see type	see type	n/a

Formal Propositions

WR21	Date must be a valid calendar date

5.10.3. Interface Definitions

- I_CalendarDate

5.11. Class IfcCoordinatedUniversalTimeOffset

5.11.1. Class Semantic Definition

The time by which local time is offset from the time basis (normally selected as Greenwich Mean Time - also referred to as Zulu).

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

5.11.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default

	HourOffset	The number of hours by which local time is offset from basis time.	IfcHourInDay	see type	see type	n/a
OPT	MinuteOffset	The number of minutes by which local time is offset from basis time.	IfcMinuteInHour	see type	see type	NIL
	Sense	The direction of the coordinated universal time offset. Note: The data type of the value is an enumeration - Ahead means positive offset; Behind means negative offset.	IfcAheadOrBehind	see type	see type	TRUE

5.11.3. Interface Definitions

- I_CoordinatedUniversalTimeOffset

5.12. Class IfcDateAndTime

5.12.1. Class Semantic Definition

A complete specification of date and time.

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

5.12.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	DateComponent	The date component when date and time are both required.	IfcCalendarDate	see type	see type	n/a
	TimeComponent	The time component when date and time are both required.	IfcLocalTime	see type	see type	n/a

5.12.3. Interface Definitions

- I_DateAndTime

5.13. Class IfcLocalTime

5.13.1. Class Semantic Definition

The accepted time indicated by a normal time measuring device at the location of interest.

NOTE: Local time is indicated as clock time rather than solar time since, locally, clock time may be displaced from solar time by a daylight saving value.

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

5.13.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	HourComponent	The hour component of the local time.	IfcHourInDay	see type	see type	n/a
OPT	MinuteComponent	The minute component of the local time.	IfcMinuteInHour	see type	see type	NIL
OPT	SecondComponent	The second component of the local time.	IfcSecondInMinute	see type	see type	NIL
OPT	Zone	The time zone in which local time is indicated as measured by the coordinated universal time offset.	IfcCoordinatedUniversalTimeOffset	see type	see type	n/a
OPT	DaylightSavingOffset	The offset of daylight saving time from basis time.	IfcDaylightSavingNumber	see type	see type	NIL

Formal Propositions

WR21	Local time must be valid.

5.13.3. Interface Definitions

- I_LocalTime

5.14. Function IfcLeapYear

5.14.1. Function Semantic Definition

Checks if the year is a leap year.

5.15. Function IfcValidCalendarDate

5.15.1. Function Semantic Definition

Checks that calendar date has a valid value.

5.16. Function IfcValidTime

5.16.1. Function Semantic Definition

Checks that local time has a valid value, i.e. checks that if second component is specified then also minute component is specified for the local time.

6. IfcDocumentResource

The IfcDocumentResource schema defines object types related to the documents and document management in AEC/FM industry projects.

Model/Document references: This release defines one way references, from the model to documents. These references include information about the document type, owner, creation date, last modified date, revision, location, etc.

6.1. Class IfcDocumentReference

6.1.1. Class Semantic Definition

Objectified model reference to a project document.

ISSUES: See IRD issues 476, 489, 516, 517.

History

New Entity in IFC Release 2.0

6.1.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	DocumentType	Describe the type of document referenced, providing a description, file extension and list of registered applications that can edit this document type.	IfcDocumentType	n/a	n/a	0
	DocumentName	File name or document name assigned by owner	STRING	n/a	n/a	empty string
OPT	DocumentDescription	Description of document	STRING	n/a	n/a	empty string
	Location	URL, pathname or physical location of the document	STRING	n/a	n/a	empty string
	DocumentOwner	Information about the person and/or organization acknowledged as the 'owner' of this document. In some contexts, the document owner determines who has access to or editing right to the document.	IfcActorSelect	n/a	n/a	n/a
	PreparedBy	List of people who have created this document	LIST [0:?] OF IfcActorSelect	n/a	n/a	n/a
	CreationDate	Date and time stamp when the document was originally created.	IfcDateAndTime	n/a	n/a	n/a
	Editors	List of people who have have permission to edit this document	LIST [0:?] OF IfcActorSelect	n/a	n/a	n/a
OPT	Revision	Document revision designation	STRING	n/a	n/a	empty string

OPT	DateOfRevision	Date and time stamp when this revision was registered	IfcDateAndTime	n/a	n/a	n/a
OPT	DocSectionReference	Optional reference to a section within the document.	STRING	n/a	n/a	empty string
OPT	DocumentScope	Scope for this document	STRING	n/a	n/a	empty string
OPT	DocumentPurpose	Purpose for this document	STRING	n/a	n/a	empty string
OPT	DocumentIntendedUse	Intended use for this document	STRING	n/a	n/a	empty string

6.1.3. Interface Definitions

- I_DocumentReference

6.2. Class IfcDocumentType

6.2.1. Class Semantic Definition

Defines a type of document, a standard file extension and a set of applications that can edit this document type.

ISSUES: See IRD issues 516, 517.

History

New Entity in IFC Release 2.0

6.2.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	FileExtension	File extension used by computer operating system.	STRING	n/a	n/a	n/a
	Description	Description of this document type (analogous to the "Product_data_type" in ISO 10303-41)	STRING	n/a	n/a	n/a
	EditingApplications	List of registered applications that can edit this document type.	SET [0:?] OF IfcApplication	n/a	n/a	empty list

6.2.3. Interface Definitions

- I_DocumentTypeDef

7. IfcGeometryResource

This part of the Industry Foundation Classes specifies the resources for the geometric and topological representation of the shape of a product. The specifications within the IfcGeometryResource include:

- explicit geometric and topological representation of the shape
- **attribute driven representation** of standard shapes and shape characteristics.

The **explicit geometric and topological representation** of the shape is defined following an adaptation of the ISO/CD 10303-42:1992, *Industrial Automation Systems and Integration: Product Data Representation and Exchange – Part 42: Integrated Generic Resources. Geometric and Topological Representation.* The type, class, and function semantic definition sections follow the adapted wording of the working draft, which is clearly indicated and quoted at each reference. The definitions on explicit geometric and topological representation are explicitly excluded from the copyright of the International Alliance of Interoperability

For more information on the definitions as defined in the formal ISO standard please refer to: ISO/IS 10303-42:1994, *Industrial Automation Systems and Integration: Product Data Representation and Exchange – Part 42: Integrated Generic Resources. Geometric and Topological Representation.* The formal standard can be obtained through the local publishers of standards in each individual country.

The following is within the scope of the explicit geometric and topological representation in IFC Release 2.0:

In Geometry:

- definition of points directly by their coordinate values
- definition of directions, vectors, and axis placements
- definition of parametric curves (subset of)
- definition of conic curves and elementary surfaces (subset of)
- definition of curves defined on a parametric surface (subset of)

In Topology:

- definition of fundamental topological entities, needed to define faceted B-rep's

In Geometric Shape Models:

- definition of faceted B-rep's
- definition of the creation of solid models by sweeping operations
- definition of half-spaces (subset of)
- definition of constructive solid geometry (CSG) models (subset of)

The **attribute driven representation** of standard shapes and shape characteristics is defined as the IFC enhancement of the geometry resource. It provides the definition of standard shapes, like extruded area segments or revolved area segments, and characteristics, in particular for the profile and path used within sweep operations to create solid models. The attributes of standard shape characteristics will later be linked to the semantic property definition of the product, so that the product's shape properties will drive the creation of the appropriate shape representation.

The following is within the scope of the attribute driven representation in IFC Release 2.0:

In Attribute Driven Geometric Shape Models:

- definition of two-dimensional bounded areas as profiles
- definition of the creation of solid models by sweeping operations, including multi segments, paths, profiles, tapering, morphing (limited) and cut-out's

7.1. Type IfcDimensionCount

7.1.1. Type Semantic Definition

Definition from ISO/CD 10303-42:1992: A dimension count is a positive integer used to define the coordinate space dimensionality.

NOTE Corresponding STEP type: *dimension_count*, please refer to ISO/IS 10303-42:1994, p. 14 for the final definition of the formal standard.

7.1.2. Type

INTEGER

Formal Propositions

WR1	The dimension count should be an integer between 1 and 3 NOTE: This is a further constraint by IFC, the upper limit does not exist in STEP

7.2. Select IfcAxis2Placement

7.2.1. Select Semantic Definition

Definition from ISO/CD 10303-42:1992: This select type collects together both versions of the placement as used in two dimensional or in three dimensional Cartesian space. This enables entities requiring this information to reference them without specifying the space dimensionality.

NOTE Corresponding STEP type: *axis2_placement,* please refer to ISO/IS 10303-42:1994, p. 19 for the final definition of the formal standard.

7.2.2. Select

IfcAxis2Placement2D
IfcAxis2Placement3D

7.3. Select IfcBooleanOperand

7.3.1. Select Semantic Definition

Definition from ISO/CD 10303-42:1992: This select type identifies all those types of entities which may participate in a Boolean operation to form a CSG solid.

Definition from IAI: CSG primitives are out of scope for the current IFC Release 1.5.1 & 2.0.

NOTE Corresponding STEP type: *boolean_operand,* please refer to ISO/IS 10303-42:1994, p.167 for the final definition of the formal standard. In IFC Release 1.5.1 & 2.0 only Boolean results (*IfcBooleanResult*), half space solids (*IfcHalfSpaceSolid*), faceted B-Rep, extruded solids and revolved solids (*IfcSolidModel*) are defined for being valid Boolean operands.

7.3.2. Select

IfcSolidModel
IfcHalfSpaceSolid
IfcBooleanResult

7.4. Select IfcCsgSelect

7.4.1. Select Semantic Definition

Definition from ISO/CD 10303-42:1992: This type identifies the types of entity which may be selected as the root of a CSG tree including a single CSG primitive as a special case (currently not in IFC).

Definition from IAI: In the current IFC Release 2.0 only Boolean result (*IfcBooleanResult*) is defined for being a root tree expression (at *IfcCsgSolid*). CSG primitives are out of scope for the current IFC Release 2.0.

NOTE Corresponding STEP type: *csg_select,* please refer to ISO/IS 10303-42:1994, p.168 for the final definition of the formal standard.

ISSUE: See I-330 for changes made in IFC Release 1.5.1

7.4.2. Select

IfcBooleanResult

7.5. Select IfcTrimmingSelect

7.5.1. Select Semantic Definition

Definition from ISO/CD 10303-42:1992: This select type identifies the two possible ways of trimming a parametric curve; by a Cartesian point on the curve, or by a REAL number defining a parameter value within the parametric range of the curve.

NOTE Corresponding STEP type: *trimming_select,* please refer to ISO/IS 10303-42:1994, p. 20 for the final definition of the formal standard.

7.5.2. Select

IfcCartesianPoint
IfcParameterValue

7.6. Select IfcVectorOrDirection

7.6.1. Select Semantic Definition

Definition from ISO/CD 10303-42:1992: This type is used to identify the types of entity which can participate in vector computations.

NOTE Corresponding STEP type: *vector_or_direction,* please refer to ISO/IS 10303-42:1994, p. 20 for the final definition of the formal standard.

7.6.2. Select

IfcVector
IfcDirection

7.7. Type IfcBooleanOperator

7.7.1. Type Semantic Definition

Definition from ISO/CD 10303-42:1992: This type defines the three Boolean operators used in the definition of CSG solids.

NOTE Corresponding STEP type: *boolean_operator,* please refer to ISO/IS 10303-42:1994, p.167 for the final definition of the formal standard.

ISSUE: See I-330 for changes made in IFC Release 1.5.1

7.7.2. Enumeration

Union	The operation of constructing the regularized set theoretic union of the volumes defined by two solids.
Intersection	The set theoretic difference between volumes defined by two solids.
Difference	The operation of constructing the regularized set theoretic intersection of the volumes defined by two solids.

7.8. Type IfcProfileTypeEnum

7.8.1. Type Semantic Definition

Definition from IAI: The enumeration defines whether the attribute driven definition of a profile shape shall be geometrically resolved into a curve or into a surface.

7.8.2. Enumeration

Curve	The resulting geometric item is of type IfcBoundedCurve and being closed. The resulting swept solid will then define only the bounding surfaces. This can be used to define shapes with thin sheets, such as ducts, where the thickness is not appropriate for geometric representation.
Area	The resulting geometric item is of type IfcCurveBoundedPlane. The resulting swept solid will be a three-dimensional body with defined volume.

7.9. Type IfcTransitionCode

7.9.1. Type Semantic Definition

Definition from ISO/CD 10303-42:1992: This type conveys the continuity properties of a composite curve or surface. The continuity referred to is geometric, not parametric continuity. For example, in *ContSameGradient* the tangent vectors of successive segments will have the same direction, but may have different magnitude.

NOTE Corresponding STEP type: *transition_code,* please refer to ISO/IS 10303-42:1994, p. 14 for the final definition of the formal standard.

7.9.2. Enumeration

Discontinuous	The segments do not join. This is permitted only at the boundary of the curve or surface to indicate that it is not closed.
Continuous	The segments join but no condition on their tangents is implied.
ContSameGradient	The segments join and their tangent vectors or tangent planes are parallel and have the same direction at the joint: equality of derivatives is not required.
ContSameGradientSameCurvature	For a curve, the segments join, their tangent vectors are parallel and in the same direction and their curvatures are equal at the joint: equality of derivatives is not required. For a surface this implies that the principle curvatures are the same and the principle directions are coincident along the common boundary.

7.10. Type IfcTrimmingPreference

7.10.1. Type Semantic Definition

Definition from ISO/CD 10303-42:1992: This type is used to describe the preferred way of trimming a parametric curve where the trimming is multiply defined.

NOTE Corresponding STEP type: *trimming_preference,* please refer to ISO/IS 10303-42:1994, p. 18 for the final definition of the formal standard.

7.10.2. Enumeration

Cartesian	Indicates that trimming by Cartesian point is preferred.
Parameter	Indicates the preference for the parameter value.
Unspecified	Indicates that no preference is communicated.

7.11. Class Ifc2DCompositeCurve

7.11.1. Class Semantic Definition

Definition from IAI: An Ifc2DCompositeCurve is an IfcCompositeCurve that is defined within the coordinate space of an IfcPlane. Therefore the dimensionality of the Ifc2DCompositeCurve has to be 2.

NOTE This class has been introduced to get a more straight forward definition of surface boundaries that its counterpart in STEP: *composite_curve_on_surface* and *boundary_curve*. Since the only basis elementary surface in IFC1.5 is the plane surface, a two dimensional composite curve provides enough capability to define the boundary.

7.11.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
  IfcCurve
    IfcBoundedCurve
      IfcCompositeCurve
        Ifc2DCompositeCurve

Attributes and Relationships

No attributes defined at this level.

Formal Propositions

WR51	The composite curve shall be closed.
WR52	The dimensionality of the composite curve shall be 2

7.11.3. Interface Definitions

I_2DCompositeCurve

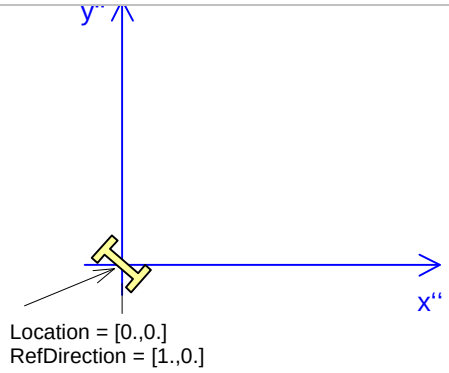
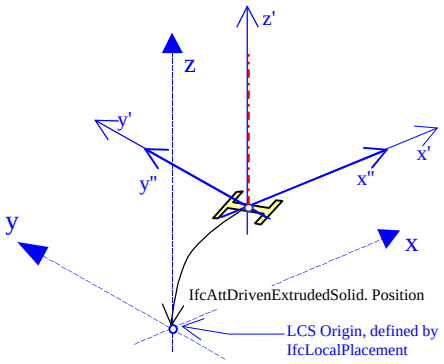
7.12. Class IfcArbitraryProfileDef

7.12.1. Class Semantic Definition

Definition from IAI: The IfcArbitraryProfileDef defines an arbitrary two-dimensional boundary to represent a profile for the use within the attribute driven geometry. It is given by an IfcBoundedCurve, from which the surface for extrusion or the surface of revolution can be constructed.

ISSUE: See issues I-239, I-291 for changes made in IFC Release 1.5.

ILLUSTRATION:

<table>
<tr>
<td> 
</td>
<td>Position
The Position attribute of the supertype for this class IfcAttDrivenProfileDef defines the 2D Placement of the Profile within the X''Y'' coordinate system, in which the bounded curve is defined. It is overwritten to Location [0.,0.] and RefDirection [1.,0.] as the ProfileDef shall not be subjected to an additional placement. Therefore the ProfileDef coordinate system (X''Y'') shall be identical with the XY plane of the coordinate system defined by the IfcAttDrivenExtrudedSegment or the IfcAttDrivenRevolvedSegment.</td>
</tr>
<tr>
<td> 
</td>
<td>The IfcArbitraryProfileDef is later positioned within the X'Y' Plane of the coordinate system defined by the
- IfcAttDrivenExtrudedSegment.Position, or by the
- IfcAttDrivenRevolvedSegment.Position.
The Position attribute defines a three dimensional placement coordinate system relative to the coordinate system, given by the IfcLocalPlacement of the semantic object for which it is the attribute driven geometric representation.
Within the X'Y' Plane as defined by the IfcAttDrivenExtrudedSegment or the IfcAttDrivenRevolvedSegment, the inherited two dimensional Position attribute defines a two-dimensional placement coordinate system (X''Y'') for the IfcBoundedCurve. The space dimensionality of the IfcBoundedCurve is therefore restricted to be 2. The location and the x- and y-axis directions are the same.</td>
</tr>
</table>

7.12.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcAttDrivenProfileDef
IfcArbitraryProfileDef

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	CurveForSurface	The definition of the closed boundary for the profile definition in terms of explicit geometry.	IfcBoundedCurve	n/a	n/a	n/a
	Position	Overwritten placement definition from the supertype IfcAttDrivenProfileDef. Always defines location [0.,0.] and RefDirection [1.,0.]	IfcAxis2Placement2D	n/a	n/a	0.,0. & (1.,0.), (0.,1.)

Formal Propositions

WR21	The IfcBoundedCurve used for curve for surface definition shall have the dimensionality of 2.

Informal Propositions

IP21	The IfcBoundedCurve used for curve for surface definition shall always be a closed bounded curve.

7.12.3. Interface Definitions

I_ArbitraryProfileDef

7.13. Class IfcAttDrivenClippedExtrudedSolid

7.13.1. Class Semantic Definition

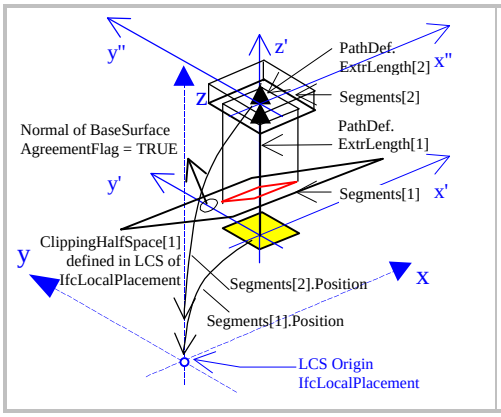
Definition from IAI: The IfcAttDrivenClippedExtrudedSolid defines a multi-segment extrusion solid by means of attribute driven geometric representation items. It is defined by

- list of extruded segments, each defining the placement coordinate system, the extrusion depth and the area of extrusion for this segment (inherited from supertype IfcAttDrivenExtrudedSolid), and
- list of half spaces, used to clip the extruded solids, that have been concatenated by a Boolean Union operation before. The half spaces are subtracted from the extruded solid in the order of their appearance in the list.

The half spaces are defined in the object coordinate system, as defined by the local placement of the semantic object.

ISSUE: See issue I-288 for changes made in IFC Release 1.5.

ILLUSTRATION:



Each IfcAttDrivenClippedExtrudedSolid additionally defines a list of half spaces, used to clip the multi-segment extruded solid. The Boolean operation "Difference" is applied between the union of Segments and each of the Clipping Half Spaces.
The result is an solid, defined by the union of all Segments and difference with each half space.

7.13.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
  IfcSolidModel
    IfcAttDrivenExtrudedSolid
      IfcAttDrivenClippedExtrudedSolid

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	ClippingHalfSpaces	Half spaces defined in Object	LIST [1:?] OF	1	N	1

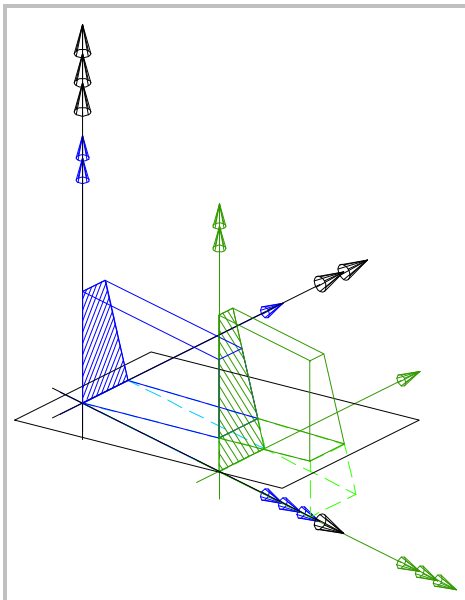
		Coordinate System of IfcLocalPlacement, that are used to clip the extruded solid.	IfcHalfSpaceSolid			

7.13.3. Interface Definitions

I_AttDrivenClippedExtrudedSolid

7.13.4. Geometry Use Definitions

Object Geometry in Context:



Example:
The figure shows the usage of IfcAttDrivenClippedExtrudedSolid to define a stepped trapezoidal solid with a sloping.

- Black arrows show LCS of IfcLocalPlacement (Object Coordinate System)
- Blue arrows show LCS of first IfcAttDrivenExtrudedSegment (defined by Position attribute)
- Green arrows show LCS of second IfcAttDrivenExtrudedSegment (defined by Position attribute)

The clipping Half Space (here unbounded) is defined in the LCS of IfcLocalPlacement (black arrows)

7.14. Class IfcAttDrivenClippedRevolvedSolid

7.14.1. Class Semantic Definition

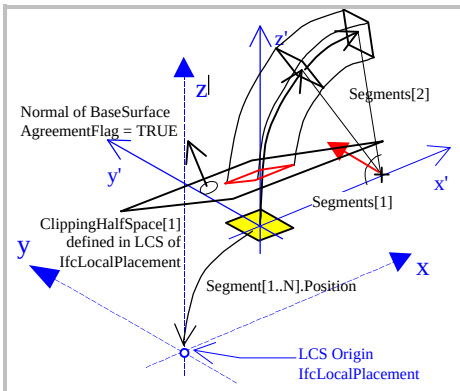
Definition from IAI: The IfcAttDrivenClippedRevolvedSolid defines a revolved solid by means of attribute driven geometric representation items. It is defined by

- list of revolved segments, each defining the start and sweep angle of revolution and the area of revolution for this segment, and
- list of half spaces, used to clip the extruded solids, that have been concatenated by a Boolean Union operation before. The half spaces are subtracted from the extruded solid in the order of their appearance in the list.

The half spaces are defined in the coordinate system, defined by the local placement of the semantic object.

ISSUE: See issue I-288 for changes made in IFC Release 1.5.

ILLUSTRATION:



Each IfcAttDrivenClippedRevolvedSolid additionally defines a list of half spaces, used to clip the multi-segment extruded solid. The Boolean operation "Difference" is applied between the union of Segments and each of the Clipping Half Spaces.
The result is an solid, defined by the union of all Segments and difference with each half space.

7.14.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcSolidModel
IfcAttDrivenRevolvedSolid
IfcAttDrivenClippedRevolvedSolid

Attributes and Relationships

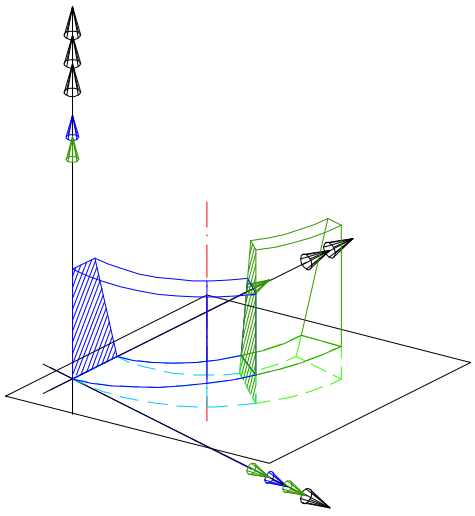
	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	ClippingHalfSpaces	Half spaces defined in Object Coordinate System of IfcLocalPlacement, that are used to clip the extruded solid.	LIST [1:?] OF IfcHalfSpaceSolid	1	N	1

7.14.3. Interface Definitions

I_AttDrivenClippedRevolvedSolid

7.14.4. Geometry Use Definitions

Object Geometry in Context



Example:
The figure shows the usage of IfcAttDrivenClippedRevolvedSolid to define a stepped trapezoidal rotated solid with a sloping base.

- Black arrows show LCS of IfcLocalPlacement (Object Coordinate System)
- Blue arrows show LCS of first IfcAttDrivenRevolvedSegment (defined by Position attribute)
- Green arrows show LCS of second IfcAttDrivenRevolvedSegment (defined by Position attribute)

Both, first and second segment, refer to the same physical instance of LCS, IfcAxis2Placement3D. The clipping Half Space (here unbounded) is defined in the LCS of IfcLocalPlacement (black arrows)

7.15. Class IfcAttDrivenExtrudedSegment

7.15.1. Class Semantic Definition

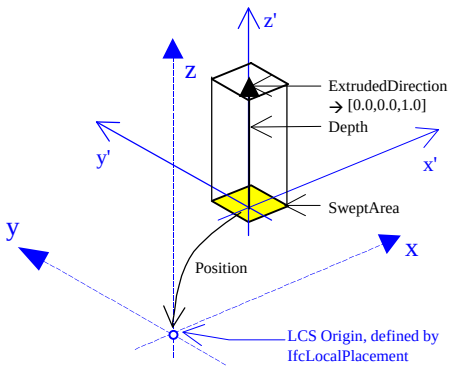
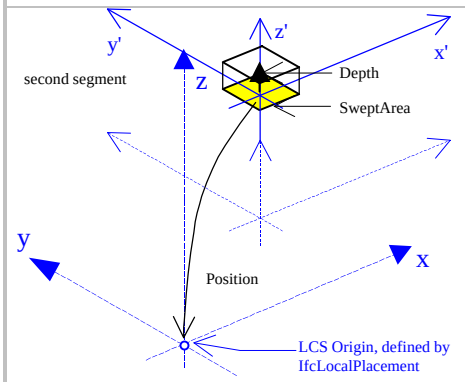
Definition from IAI: The IfcAttDrivenExtrudedSegment is the attribute driven definition of an extruded area solid segment of the multi-segment swept solid, the IfcAttDrivenExtrudedSolid. It is defined by a swept area, provided by the start profile definition, which remains unchanged over the extruded depth. This swept area is extruded along the extrusion direction, as given by the IfcAttDrivenExtrudedSolid.

The following parameter are specified:

- placement within a three dimensional coordinate system,
- profile definition, defines the extruded area by attributes according to standard forms, or by an arbitrary closed bounded curve,
- extruded area (inherited from supertype IfcSweptAreaSolid), derived by function IfcProfileIntoArea out of the profile definition,
- extruded direction (inherited from supertype IfcExtrudedAreaSolid), derived as being along the z- axis, defined by the position of the IfcAttDrivenExtrudedSolid,
- extruded depth (inherited from supertype IfcExtrudedAreaSolid)

ISSUE: See issues I-028, I-234, I-292 for changes made in IFC Release 1.5.

ILLUSTRATION:

	The IfcAttDrivenExtrudedSegment defines its own three-dimensional placement coordinate system relative to the coordinate system provided by the IfcLocalPlacement of the semantic object for which it is the attribute driven geometric representation. The IfcAttDrivenExtrudedSegment is defined by a start profile definition. From this profile definition the swept area is derived. The extrusion is always in the direction of the normal of the swept area. The swept area is provided as IfcCurveBoundedPlane with the basis surface of IfcPlane. The position of the IfcPlane, also defining the normal of the plane, is identical to the placement coordinate system, as defined by the IfcAttDrivenExtrudedSolid.
	Each segment is located by its own placement coordinate system relative to the coordinate system provided by the IfcLocalPlacement. A constraint applies to all placement coordinate systems of segments within one IfcAttDrivenExtrudedSolid. The Z' Axis of placement coordinate system of all segments shall be defined along a line.

7.15.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
  IfcSolidModel
    IfcSweptAreaSolid
      IfcExtrudedAreaSolid
        IfcAttDrivenExtrudedSegment
          IfcAttDrivenTaperedExtrudedSegment

IfcAttDrivenMorphedExtrudedSegment

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Position	Placement of the extruded solid segment relative to the local coordinate system of the product.	IfcAxis2Placement3D	n/a	n/a	n/a
	ProfileDef	The attribute driven definition of the profile, from which the swept area can be derived.	IfcAttDrivenProfileDef	n/a	n/a	n/a
	SweptArea	The derived swept area, that specifies the surface defining the area to be swept. It is defined as a bounded planar surface, coplanar with the X'Y' plane of the placement coordinate system.	IfcCurveBoundedPlane	n/a	n/a	n/a
	ExtrudedDirection	The derived direction, in which the surface is to be swept. It is always in the direction of the z-axis of the placement coordinate system, as defined by the IfcAttDrivenExtrudedSolid, and thereby identical with the normal of the swept area.	IfcDirection	see type	see type	(0.0,0.0,1.0)
INV	PartOfSolid	The reference to the IfcAttDrivenExtrudedSolid, for which it defines a segment.	IfcAttDrivenExtrudedSolid	n/a	n/a	n/a

Formal Propositions

WR51	Only Profile Definitions, defining an area for extrusion are valid for ProfileDef.

7.15.3. Interface Definitions

I_AttDrivenExtrudedSegment

7.16. Class IfcAttDrivenExtrudedSolid

7.16.1. Class Semantic Definition

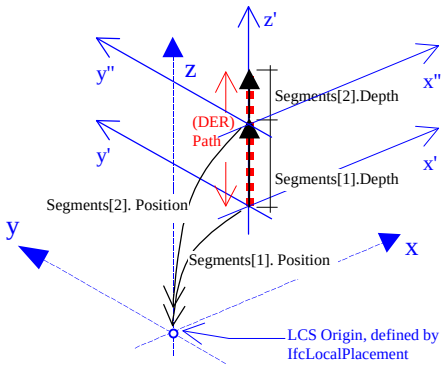
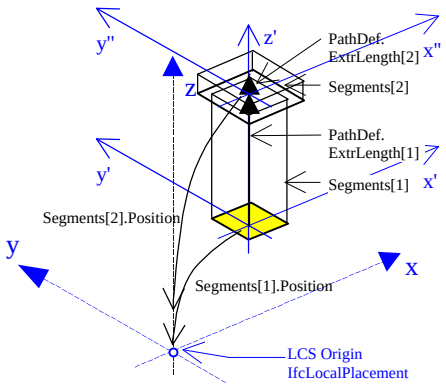
Definition from IAI: The IfcAttDrivenExtrudedSolid defines a multi-segment extrusion solid by means of attribute driven geometric representation items. It is defined by

- list of extruded segments, each defining the placement coordinate system, the extrusion depth and the area of extrusion for this segment.

The resulting solid is the union of all segments. The IfcAttDrivenExtrudedSolid also provides the derived definition of the extrusion path. The applied convention hereby is, that the extruded direction is always along the Z- Axis of the placement coordinate systems, defined by the Position attribute within all Segments. The extrusion depth parameter are defined for each Segment, therefore the path length is the sum of all extrusion depths as specified by the extruded segments.

ISSUE: See issue I-027, I-228, I-229, I-230, I-292 for changes made in IFC Release 1.5.

Example:

	The implied extrusion path is defined along the Z' axes of the placement coordinate systems of all Segments. For each extruded segment there is an extrusion depth definition provided. Those extrusion depths are defined consecutively. The complete extrusion path has the length of the sum of all extrusion depths defines in the Segment list. The IfcAttDrivenExtrudedSolid therefore allows for multiple segment solids. Since only multiple straight segments along the same line are allowed, there are no conflicts at the joints.
	Each IfcAttDrivenExtrudedSegment within the list of Segments defines an solid of linear extrusion. The IfcAttDrivenExtrudedSolid provides the formal and informal propositions to ensure, that a common extrusion direction is specified for all Segments. The result is an solid, defined by the union of all Segments.

7.16.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcSolidModel
IfcAttDrivenExtrudedSolid
IfcAttDrivenClippedExtrudedSolid

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Segments	Definition of extruded segments, each segment has a start and can have a different end swept area, provided by an attribute driven profile definition. If the start profile is not identical with the end profile of the previous segment, that a stepped extrusion solid is generated.	LIST [1:?] OF IfcAttDrivenExtrudedSegment	1	N	1
	Path	The derived specification of the extrusion path, given by a polyline as explicit geometric representation.	IfcPolyline	n/a	n/a	n/a

Formal Propositions

WR31	The P[3] attribute (Z axis) of all Segments shall have the same direction.

Informal Propositions

IP31	The Location attribute of the Position for all Segments shall guarantee, that the Z-axis of all placement coordinate systems of all Segments shall be defined along a line.
IP32	The Location attribute of the Position for all Segments shall guarantee, that the start surface of the

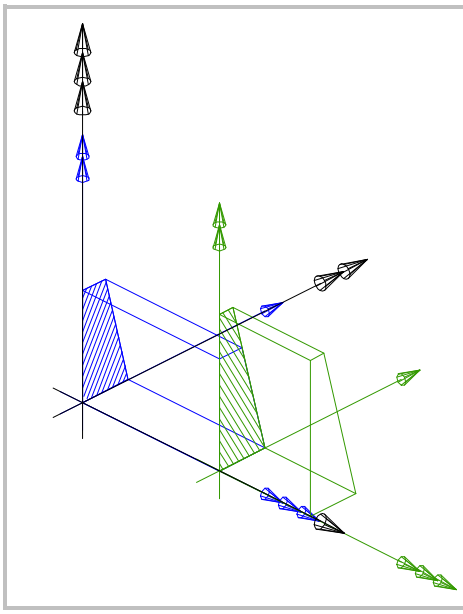
	next Segment is coplanar with the end surface of the previous Segment.

7.16.3. Interface Definitions

I_AttDrivenExtrudedSolid

7.16.4. Geometry Use Definitions

Object Geometry in Context



Example:
The figure shows the usage of IfcAttDrivenExtrudedSolid to define a stepped trapezoidal solid.

- Black arrows show LCS of IfcLocalPlacement (Object Coordinate System)
- Blue arrows show LCS of first IfcAttDrivenExtrudedSegment (defined by Position attribute)
- Green arrows show LCS of second IfcAttDrivenExtrudedSegment (defined by Position attribute)

7.17. Class IfcAttDrivenMorphedExtrudedSegment

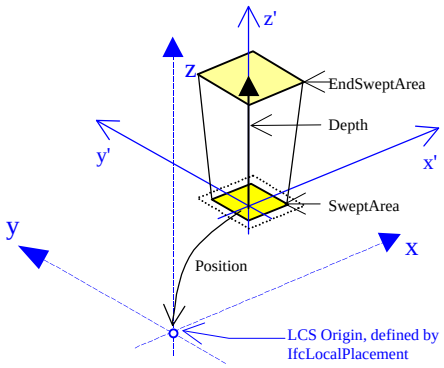
7.17.1. Class Semantic Definition

Definition from IAI: The IfcAttDrivenMorphedExtrudedSegment is the attribute driven definition of an extruded area solid segment of the multi-segment swept solid, the IfcAttDrivenExtrudedSolid. It is defined by a starting swept area, provided by the start profile definition and the ending swept area, provided by the end profile definition. The morphed extruded segment is restricted in the current release. A set of constrains apply to the definitions of start and end profile. In particular, they shall have the same number of points and the same type of segments between each two consecutive points.

The geometric resolution of the resulting surfaces and/or volume is left for the receiving application. The constraints applied in formal and informal propositions, however, limit results.

ISSUE: See issues I-031, I-237, I-293 for changes made in IFC Release 1.5

ILLUSTRATION:



The IfcAttDrivenMorphedExtrudedSegment provides an end profile definition from with the ending swept area is derived.
The start profile, extruded direction and depth are specified at the supertype IfcAttDrivenExtrudedSegment. The same conventions apply.

7.17.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcSolidModel
IfcSweptAreaSolid
IfcExtrudedAreaSolid
IfcAttDrivenExtrudedSegment
IfcAttDrivenMorphedExtrudedSegment

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	EndProfileDef	The attribute driven definition of the profile, from which the swept area can be derived.	IfcAttDrivenProfileDef	-	-	-
	EndSweptArea	The derived swept area, that specifies the surface defining the area to be swept.	IfcCurveBoundedPlane	-	-	-

Formal Propositions

WR61	The type of start profile definition shall be the same as the type of end profile definition.
WR62	The use of IfcArbitraryProfileDef is not allowed for morphing profiles.
WR63	The relative position of start and end profiles shall have the same orientation.

Informal Propositions

IP61	The configuration of start and end profile definition shall not generate a twisted sweep.
IP62	Corresponding straight edges of the starting and ending profiles shall be coplanar to ensure that the resulting side faces are planar.

7.17.3. Interface Definitions

I_AttDrivenMorphedExtrudedSegment

7.18. Class IfcAttDrivenMorphedRevolvedSegment

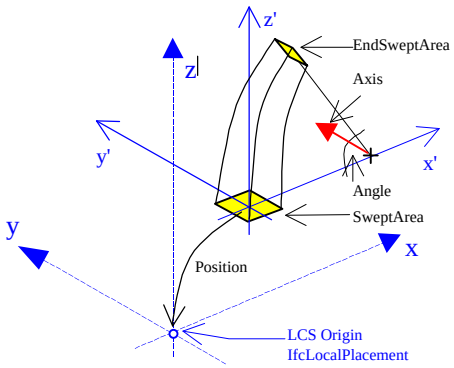
7.18.1. Class Semantic Definition

Definition from IAI: The IfcAttDrivenMorphedRevolvedSegment is the attribute driven definition of an revolved area solid segment of the multi-segment swept solid, the IfcAttDrivenRevolvedSolid. It is defined by a starting swept area, provided by the start profile definition and the ending swept area, provided by the end profile definition. The morphed revolved segment is restricted in the current release. A set of constrains apply to the definitions of start and end profile. In particular, they shall have the same number of points and the same type of segments between each points. This swept area is extruded around the axis.

The geometric resolution of the resulting surfaces and/or volume is left for the receiving application. The constraints applied in formal and informal propositions, however, limit results.

ISSUE: See issue I-031, I-238 for changes made in IFC Release 1.5

ILLUSTRATION:



The IfcAttDrivenMorphedRevolvedSegment provides an end profile definition from with the ending swept area is derived.
The start profile, axis and angle are specified at the supertype IfcAttDrivenRevolvedSegment. The same conventions apply.

7.18.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
  IfcSolidModel
    IfcSweptAreaSolid
      IfcRevolvedAreaSolid
        IfcAttDrivenRevolvedSegment
          IfcAttDrivenMorphedRevolvedSegment

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	EndProfileDef	The attribute driven definition of the profile, from which the swept area can be derived.	IfcAttDrivenProfileDef	n/a	n/a	n/a
	EndSweptArea	The derived swept area, that specifies the surface defining the area to be swept.	IfcCurveBoundedPlane	n/a	n/a	n/a

Formal Propositions

WR61	The type of start profile definition shall be the same as the type of end profile definition.
WR62	The use of IfcArbitraryProfileDef is not allowed for morphing profiles.
WR63	The relative position of start and end profiles shall have the same orientation.

Informal Propositions

IP61	The configuration of start and end profile definition shall not generate a twisted sweep.
IP62	Corresponding edges at the start and end profile shall be parallel.

7.18.3. Interface Definitions

I_AttDrivenMorphedRevolvedSegment

7.19. Class IfcAttDrivenProfileDef

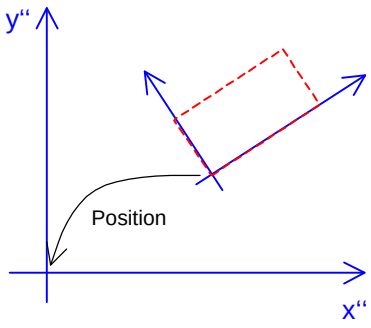
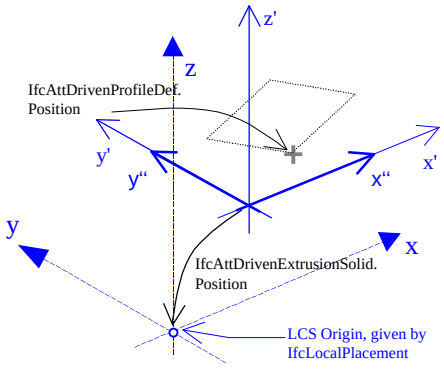
7.19.1. Class Semantic Definition

Definition from IAI: The IfcAttDrivenProfileDef is the supertype of all attribute driven definitions of the profile (or cross section) geometry in IFC. It is used to define a standard set of commonly used shapes of profiles including their attributes.

Currently all IfcAttDrivenProfileDef are treated as bounded areas, as they are used within the IfcAttDrivenExtrudedSegment or IfcAttDrivenRevolvedSegment for swept area solids. In other words, the inside of an IfcAttDrivenProfileDef is a part of the profile. The inside is defined in a way consistent with that for ISO 10303-42:1994 *curve_bounded_surface*.

ISSUE: See issues I-033, I-183, I-239 for changes made in IFC Release 1.5.

ILLUSTRATION:

	The IfcAttDrivenProfileDef defines a two-dimensional placement coordinate system for the attribute driven profile definitions of standard forms, relative to the coordinate system in which the resulting bounded curve is defined.
	In the later use of the IfcAttDrivenProfileDef within the - IfcAttDrivenExtrudedSolid or the - IfcAttDrivenRevolvedSolid the underlying coordinate system of the resulting bounded curve (X''Y'') is placed at the Location of the Position defined by the IfcAttDrivenExtrudedSegment or IfcAttDrivenRevolvedSegment (X'Y') and the x- and y- axis directions are the same.

7.19.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcAttDrivenProfileDef
IfcArbitraryProfileDef
IfcCircleProfileDef
IfcRectangleProfileDef
IfcTrapeziumProfileDef

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Position	Placement of the profile within the X'Y' plane defined by the Path Definition.	IfcAxis2Placement2D	see type	see type	0.,0. & (1.,0.), (0.,1.)
	ProfileType	Defines the type of geometry into which this profile definition shall be resolved, either bounded curve or bounded surface	IfcProfileTypeEnum	Curve	Area	Area

7.19.3. Interface Definitions

I_AttDrivenProfileDef

7.20. Class IfcAttDrivenRevolvedSegment

7.20.1. Class Semantic Definition

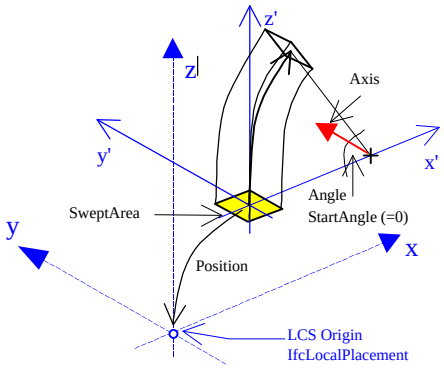
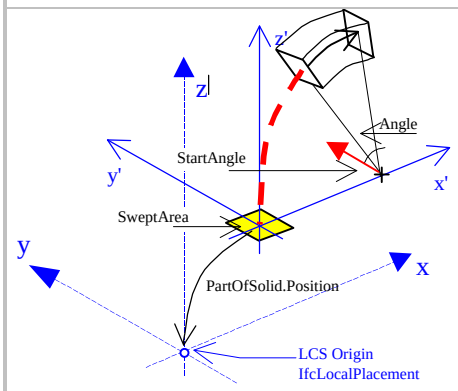
Definition from IAI: The IfcAttDrivenRevolvedSegment is the attribute driven definition of an revolved area solid segment of the multi-segment swept solid, the IfcAttDrivenRevolvedSolid. It is defined by a swept area, provided by the definition of the start profile, which is rotated over the revolved angle.

The following parameter are specified:

- placement within a three dimensional coordinate system, that defines the position of the normal of the first segment,
- profile definition, which defines the revolved,
- revolved area (inherited from supertype IfcSweptAreaSolid), derived by function IfcProfileIntoArea out of the profile definition,
- axis for revolution (inherited from supertype IfcRevolvedAreaSolid),
- sweep angle (inherited from supertype IfcRevolvedAreaSolid)
- start angle

ISSUE: See issues I-028, I-235, I-292 for changes made in IFC Release 1.5.

ILLUSTRATION:

	The IfcAttDrivenRevolvedSegment defines its own three-dimensional coordinate system relative to the coordinate provided by the IfcLocalPlacement of the semantic object for which it is the attribute driven geometric representation. The IfcAttDrivenRevolvedSegment is defined by a start profile definition. From this profile definition the swept area is derived. The revolution is always around the axis, which has to be identical for all Segments. The swept area is provided as IfcCurveBoundedPlane with the basis surface of IfcPlane. The position of the IfcPlane, also defining the normal of the plane, is identical to the placement coordinate system, as defined by the IfcAttDrivenRevolvedSolid.
	If the said IfcAttDrivenRevolvedSegment is not the first of the list of Segments at the IfcAttDrivenRevolvedSolid, i.e. the StartAngle <> 0.0, then the SweptArea is first rotated by the value of StartAngle.

7.20.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
  IfcSolidModel
    IfcSweptAreaSolid
      IfcRevolvedAreaSolid
        IfcAttDrivenRevolvedSegment
          IfcAttDrivenTaperedRevolvedSegment
          IfcAttDrivenMorphedRevolvedSegment

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Position	Placement of the revolved solid relative to the local coordinate system of the product.	IfcAxis2Placement3D	-	-	-
	StartAngle	Angle by which the SweptArea is rotated first, before the revolution by the Angle.	IfcPlaneAngleMeasure	0	see IR1	p/2
	ProfileDef	The attribute driven definition of the profile, from which the swept area can be derived.	IfcAttDrivenProfileDef	-	-	-
	SweptArea	The derived swept area, that specifies the surface defining the area to be swept.	IfcCurveBoundedPlane	-	-	-
INV	PartOfSolid	The reference to the IfcAttDrivenExtrudedSolid, for which it defines a segment.	IfcAttDrivenRevolvedSolid	-	-	-

Formal Propositions

WR51	The Location of the sweep Axis shall always be defined at the X'Y' plane of the placement coordinate system.
WR52	

Informal Propositions

IP51	The sum of Start Angle and Angle (as defined in supertype IfcRevolvedAreaSolid) shall be between 0° and 360°, or 0 and 2p (depending on the unit type for Plane Angle Measure).

7.20.3. Interface Definitions

I_AttDrivenRevolvedSegment

7.21. Class IfcAttDrivenRevolvedSolid

7.21.1. Class Semantic Definition

Definition from IAI: The IfcAttDrivenRevolvedSolid defines a revolved solid by means of attribute driven geometric representation items. It is defined by

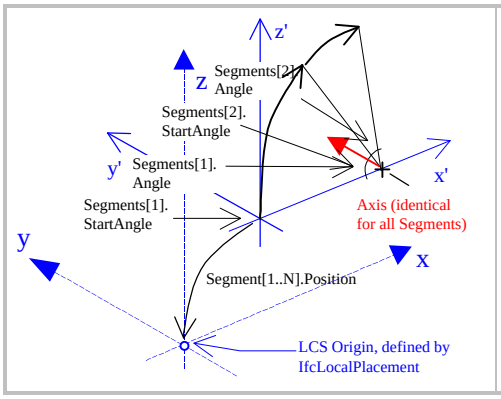
- list of revolved segments, each defining the start and sweep angle of revolution and the area of revolution for this segment.

The resulting solid is the union of all segments. The IfcAttDrivenRevolvedSolid also provides the derived definition of the arc defining the path of revolution. The arc starts in the origin, given by the location of the placement coordinate system of the first Segment. The angle of revolution parameters are defined at each Segment, where the start angle equals to the start angle + sweep angle of the previous Segment. The arc length of the path is therefore derived from the start angle + sweep angle at the last Segment.

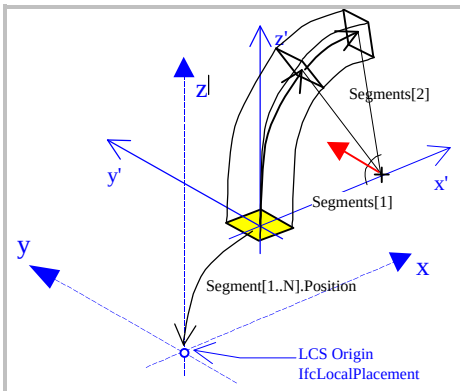
The IfcAttDrivenRevolvedSolid also provides constraints for the placement coordinate systems of the Segments, all shall refer to the same instance of IfcAxis2Placement3D. In addition, the Axis defined at all Segments shall be identical.

ISSUE: See issues I-027, I-231, I-232, I-233, I-292, I-294 for changes made in IFC Release 1.5.

ILLUSTRATION:

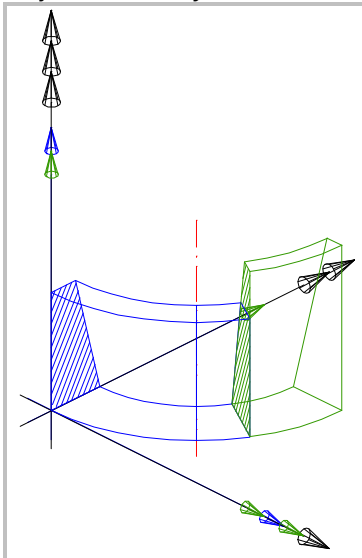


For each revolved Segment there is an start and sweep angle definition provided. The complete revolution arc has the arc length of the sum of all sweep angles defines in the Segment list.
The IfcAttDrivenRevolvedSolid therefore allows for multiple segment solids. Since all segments have the same axis, there are no conflicts at the joints.



Each IfcAttDrivenRevolvedSegment within the list of Segments defines an solid of revolution. The IfcAttDrivenRevolvedSolid ensures the use of a common placement coordinate system an a common axis for all Segments. The result is the union of all Segments.

Object Geometry in Context:



Example:
The figure shows the usage of IfcAttDrivenRevolvedSolid to define a stepped trapezoidal rotated solid.

- Black arrows show LCS of IfcLocalPlacement (Object Coordinate System)
- Blue arrows show LCS of first IfcAttDrivenRevolvedSegment (defined by Position attribute)
- Green arrows show LCS of second IfcAttDrivenRevolvedSegment (defined by Position attribute)

Both, first and second segment, refer to the same physical instance of LCS, IfcAxis2Placement3D.

7.21.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcSolidModel
IfcAttDrivenRevolvedSolid
IfcAttDrivenClippedRevolvedSolid

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Segments	Definition of revolved segments, each segment has a start and can have a different end swept area, provided by an attribute driven profile definition. If the start profile is not identical with the end profile of the previous segment, that a stepped solid is generated.	LIST [1:?] OF IfcAttDrivenRevolvedSegment	1	N	1
	Path	The derived specification of the path of revolution, given by a trimmed curve as explicit geometric representation.	IfcTrimmedCurve	n/a	n/a	n/a

Formal Propositions

WR31	All Segments shall reference the same instance of the placement coordinate system.
WR32	All Segments shall define an identical Axis for revolution.

Informal Propositions

IP31	The StartAngle of the next Segment shall equal to the sum of sweep Angle of the previous Segments.

7.21.3. Interface Definitions

I_AttDrivenRevolvedSolid

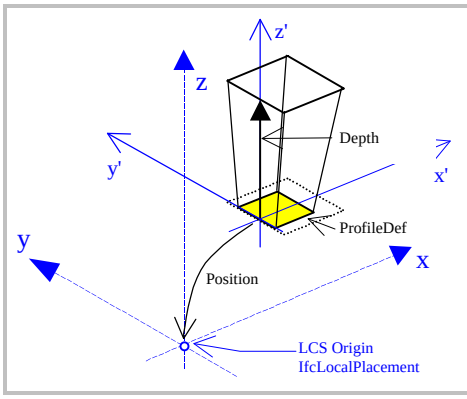
7.22. Class IfcAttDrivenTaperedExtrudedSegment

7.22.1. Class Semantic Definition

The IfcAttDrivenTaperedExtrudedSegment is the attribute driven definition of an extruded area solid segment of the multi-segment swept solid, the IfcAttDrivenExtrudedSolid. It is defined by a start swept area, provided by the start profile definition, which will be linearly changed during the sweep operation according to a tapering ratio. Therefore the implicitly defined end swept area is a scaled variant of the start swept area.

ISSUE: See issue I-296 for changes made in IFC Release 1.5

ILLUSTRATION:



The start profile, extruded direction and depth are specified at the supertype IfcAttDrivenExtrudedSegment. The same conventions apply. The end profile is implicitly calculated by applying the tapering ratio to the start profile. The tapering factor describes whether the profile increases (factor > 1.0) or decreases (1.0 > factor > 0.0). The position of the profile against the path is important, since the tapering factor takes this relative position into account.

7.22.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
  IfcSolidModel
    IfcSweptAreaSolid
      IfcExtrudedAreaSolid
        IfcAttDrivenExtrudedSegment
          IfcAttDrivenTaperedExtrudedSegment

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	TaperingFactor	The ratio that defines the increase/decrease of the profile along the extrusion vector.	IfcPositiveRatioMeasure	0.	see type	1

7.22.3. Interface Definitions

I_AttDrivenTaperedExtrudedSegment

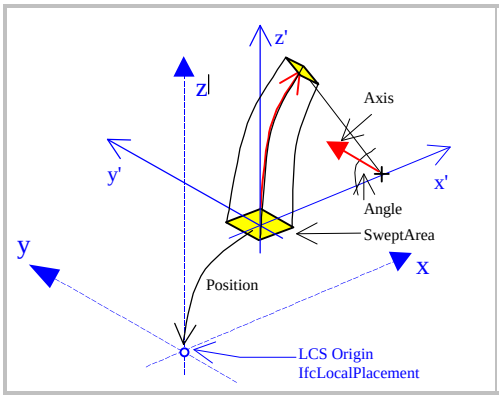
7.23. Class IfcAttDrivenTaperedRevolvedSegment

7.23.1. Class Semantic Definition

The IfcAttDrivenTaperedRevolvedSegment is the attribute driven definition of an revolved area solid segment of the multi-segment swept solid, the IfcAttDrivenExtrudedSolid. It is defined by a start swept area, provided by the start profile definition, which will be linearly changed during the sweep operation according to a tapering ratio factor. Therefore the implicitly defined end swept area is a scaled variant of the start swept area.

ISSUE: See issue I-296 for changes made in IFC Release 1.5

ILLUSTRATION:



The start profile, axis and angle are specified at the supertype IfcAttDrivenRevolvedSegment. The same conventions apply.
The end profile is implicitly calculated by applying the tapering ratio to the start profile. The tapering factor describes whether the profile increases (factor > 1.0) or decreases (1.0 > factor > 0.0). The position of the profile against the path is important, since the tapering factor takes this relative position into account.

7.23.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcSolidModel
IfcSweptAreaSolid
IfcRevolvedAreaSolid
IfcAttDrivenRevolvedSegment
IfcAttDrivenTaperedRevolvedSegment

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	TaperingFactor	The ratio that defines the increase/decrease of the profile along the extrusion vector.	IfcPositiveRatioMeasure	0.	see type	1

7.23.3. Interface Definitions

I_AttDrivenTaperedRevolvedSegment

7.24. Class IfcAxis1Placement

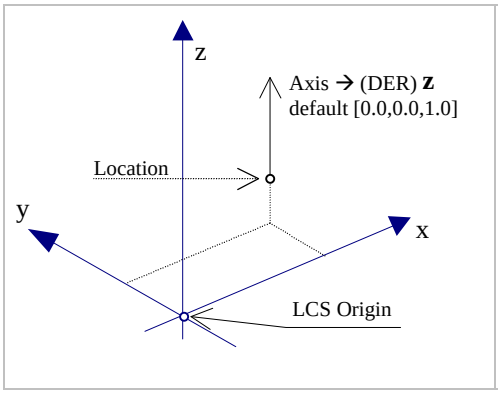
7.24.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: The direction and location in three dimensional space of a single axis. An *IfcAxis1Placement* is defined in terms of a locating point (inherited from IfcPlacement supertype) and an axis direction: this is either the direction of *Axis* or defaults to (0.0,0.0,1.0). The actual direction for the axis placement is given by the derived attribute *Z*.

NOTE Corresponding STEP name: *axis1_placement,* please refer to ISO/IS 10303-42:1994, p. 28 for the final definition of the formal standard.

ISSUE: See issue I-008 for changes made in IFC Release 1.5.
See issues I-332, I-344 for changes made in IFC Release 1.5.1

Illustration:



Definition of the IfcAxis1Placement within the three-dimensional coordinate system.

7.24.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
  IfcPlacement
    IfcAxis1Placement

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
OPT	Axis	The direction of the local Z axis	IfcDirection	n/a	n/a	NIL
	Z	The normalized direction of the local Z axis. It is either identical with the Axis value, if given, or it defaults to [0.,0.,1.]	IfcDirection	n/a	n/a	(0.,0.,1.)

Formal Propositions

WR31	The Axis when given should only reference a three-dimensional IfcDirection
WR32	The Cartesian point defining the Location shall have the dimensionality of 3.

7.24.3. Interface Definitions

I_Axis1Placement

7.25. Class IfcAxis2Placement2D

7.25.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: The location and orientation in two dimensional space of two mutually perpendicular axes. An IfcAxis2Placement2D is defined in terms of a point, (inherited from the IfcPlacement supertype), and an axis. It can be used to locate and originate an object in two dimensional space and to define a Placement Coordinate System. The class includes a point which forms the origin of the Placement Coordinate System. A direction vector is required to complete the definition of the Placement Coordinate System. The reference direction defines the placement X axis direction, the placement Y axis is derived from this.

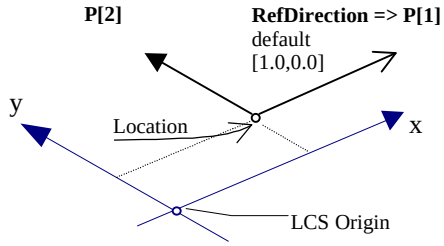
Definition from IAI: If the RefDirection attribute is not given, the placement defaults to P[1] (x-axis) as [1.,0.] and P[2] (y-axis) as [0.,1.].

NOTE Corresponding STEP name: *axis2_placement_2d,* please refer to ISO/IS 10303-42:1994, p. 28 for the final definition of the formal standard.

HISTORY New class in IFC Release 1.5, the IFC Release 1.0 entity IfcPlacement_2D was using two normalized and orthogonal axes. This definition is replaced in IFC Release 1.5 by the STEP definition of axis placement.

ISSUE: See issue I-008 for changes made in IFC Release 1.5.
See issues I-332, I-344 for changes made in IFC Release 1.5.1

Illustration:



Definition of the IfcAxis2Placement2D within the two-dimensional coordinate system.

7.25.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
  IfcPlacement
    IfcAxis2Placement2D

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
OPT	RefDirection	The direction used to determine the direction of the local X Axis	IfcDirection	n/a	n/a	NIL
	P	P[1]: The normalized direction of the placement X Axis. This is (1.0,0.0,0.0) if RefDirection is omitted. P[2]: The normalized direction of the placement Y Axis. This is a derived attribute and is orthogonal to P[1].	LIST [2:2] OF IfcDirection	n/a	n/a	(1.,0.), (0.,1.)

Formal Propositions

WR31	
WR32	

7.25.3. Interface Definitions

I_Axis2Placement2D

7.26. Class IfcAxis2Placement3D

7.26.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: The location and orientation in three dimensional space of three mutually perpendicular axes. An *IfcAxis2Placement3D* is defined in terms of a point (inherited from IfcPlacement supertype) and two (ideally orthogonal) axes. It can be used to locate and originate an object in three dimensional space and to define a Placement Coordinate System. The class includes a point which forms the origin of the Placement Coordinate System. Two direction vectors are required to complete the definition of the Placement Coordinate System. The Axis is the placement Z axis direction and the *RefDirection* is an approximation to the placement X axis direction.

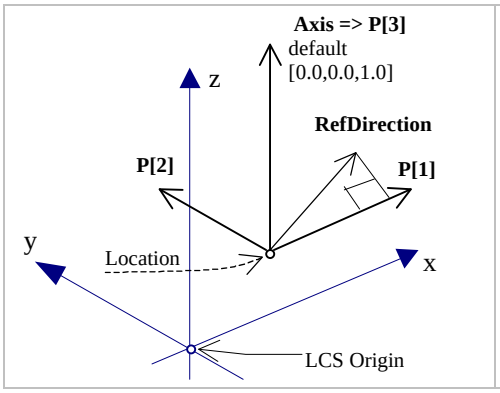
Definition from IAI: If the attribute values for Axis and RefDirection are not given, the placement defaults to P[1] (x-axis) as [1.,0.,0.], P[2] (y-axis) as [0.,1.,0.] and P[3] (z-axis) as [0.,0.,1.]

NOTE Corresponding STEP name: *axis2_placement_3d,* please refer to ISO/IS 10303-42:1994 for the final definition of the formal standard. The WR5 is added.

HISTORY New class in IFC Release 1.5, the IFC Release 1.0 entity IfcPlacement_3D was using three normalized and orthogonal axes. This definition is replaced in IFC Release 1.5 by the STEP definition of axis placement.

ISSUE: See issues I-008, I-311 for changes made in IFC Release 1.5.
See issue I-332 for changes made in IFC Release 1.5.1

Illustration:



Definition of the IfcAxis2Placement3D within the three-dimensional coordinate system.

7.26.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcPlacement
IfcAxis2Placement3D

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
OPT	Axis	The exact direction of the local Z Axis	IfcDirection	n/a	n/a	NIL
OPT	RefDirection	The direction used to determine the direction of the local X Axis. If necessary an adjustment is made to maintain orthogonality to the Axis direction. If Axis and/or RefDirection is omitted, these directions are taken from the geometric coordinate system.	IfcDirection	n/a	n/a	NIL
	P	The normalized directions of the placement X Axis (P[1]) and the placement Y Axis (P[2]) and the placement Z Axis (P[3])	LIST [3:3] OF IfcDirection	n/a	n/a	(1.,0.,0.)(0.,1.,0.)(1.,0.,0.)

Formal Propositions

WR31	The dimensionality of the placement location shall be 3
WR32	The Axis when given should only reference a three-dimensional IfcDirection
WR33	The RefDirection when given should only reference a three-dimensional IfcDirection
WR34	The Axis and RefDirection shall not be parallel or anti-parallel
WR35	Either both (Axis and RefDirection) are not given and therefore defaulted, or both shall be given. This is a further constraint in IFC Release 1.5.

7.26.3. Interface Definitions

I_Axis2Placement3D

7.27. Class IfcBooleanResult

7.27.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: A Boolean result is the result of a regularized operation on two solids to create a new solid. Valid operations are regularized union, regularized intersection, and regularized difference. For purpose of Boolean operations, a solid is considered to be a regularized set of points. The final Boolean result depends upon the operation and the two operands. In the case of the difference operator the order of the operands is also significant. The operator can be either union, intersection or difference. The effect of these operators is described below:

- Union on two solids is the new solid that is the regularization of the set of all points that are in either the first operand or the second operand or in both.
- Intersection on two solids is the new solid that is the regularization of the set of all points that are in both the first operand and the second operand.
- The result of the difference operation on two solids is the regularization of the set of all points which are in the first operand, but not in the second operand.

Definition from IAI: The following classes can be used as operands for the Boolean result:

- IfcExtrudedAreaSolid
- IfcRevolvedAreaSolid
- IfcFacetedBrep
- IfcFacetedBrepWithVoids
- IfcHalfSpaceSolid
- Boolean results of the above

NOTE Corresponding STEP entity: *boolean_result.* The derived attribute *Dim* has been added at this level and was therefore demoted from the *geometric_representation_item*. Please refer to ISO/IS 10303-42:1994, p.175 for the final definition of the formal standard.

ISSUE: See I-330 for changes made in IFC Release 1.5.1

7.27.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcBooleanResult

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Operator	The Boolean operator used in the operation to create the result.	IfcBooleanOperator	Union	Intersection	Union
	FirstOperand	The first operand to be operated upon by the Boolean operation.	IfcBooleanOperand	n/a	n/a	n/a
	SecondOperand	The second operand specified for the operation.	IfcBooleanOperand	n/a	n/a	n/a
	Dim	The space dimensionality of this entity.	IfcDimensionCount	2	3	3

Formal Propositions

WR21	The dimensionality of the first operand shall be the same as the dimensionality of the second operand.
WR22	Attribute driven geometry items shall not be used as the first operand
WR23	Attribute driven geometry items shall not be used as the second operand

7.27.3. Interface Definitions

I_BooleanResult

7.28. Class IfcBoundedCurve

7.28.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: A bounded curve is a curve of finite arc length with identifiable end points.

NOTE Corresponding STEP name: *bounded_curve*, only the following subtypes have been incorporated into IFC: *polyline* as IfcPolyline, *trimmed_curve* as IfcTrimmedCurve, *composite_curve* as IfcCompositeCurve. The derived attribute *Dim* has been added at this level and was therefore demoted from the *geometric_representation_item*. Please refer to ISO/IS 10303-42:1994, p. 44 for the final definition of the formal standard.

7.28.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcCurve
IfcBoundedCurve
IfcCompositeCurve

IfcPolyline
IfcTrimmedCurve

Attributes and Relationships

No attributes defined at this level.

Informal Propositions

IP31	A bounded curve has finite arc length.
IP32	A bounded curve has a start point and an end point.

7.28.3. Interface Definitions

I_BoundedCurve

7.29. Class IfcBoundingBox

7.29.1. Class Semantic Definition

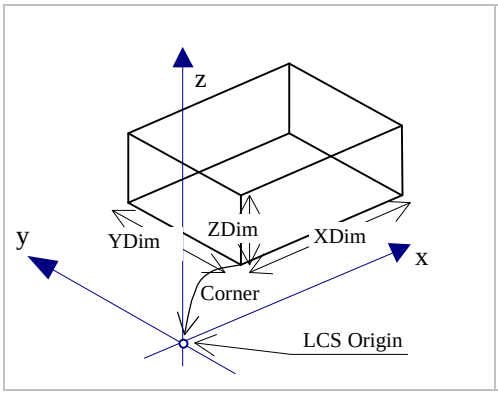
Definition from IAI: Every semantic object showing a physical extent will have a minimum default representation of a bounding box. The bounding box is the one representation that will always exist and be available. Even if more specific representations are associated with an object, the IfcBoundingBox should be updated and made consistent so that applications which may only want this minimal representation will have a valid view of the object geometry.

The general purpose bounding box is therefore used as minimal geometric representation for any geometrically represented object. Represents the minimal box which fully combines said object.

HISTORY New class in IFC Release 1.0

ISSUE: See issue I-021 for changes made in IFC Release 1.5.

Illustration:



The IfcBoundingBox is defined with an own location which can be used to place the IfcBoundingBox relative to the local coordinate system, given by the IfcLocalPlacement Class.
The IfcBoundingBox is defined by the lower left corner (Corner) and the upper right corner (XDim, YDim, ZDim measured within the parent co-ordinate system).

7.29.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcBoundingBox

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default

	Corner	Location of the bottom left corner (having the minimum values).	IfcCartesianPoint	see type	see type	[0.,0.,0.]
	XDim	Length attribute (measured along the edge parallel to the X Axis)	IfcPositiveLengthMeasure	0	see type	1
	YDim	Width attribute (measured along the edge parallel to the Y Axis)	IfcPositiveLengthMeasure	0	see type	1
	ZDim	Height attribute (measured along the edge parallel to the Z Axis)	IfcPositiveLengthMeasure	0	see type	1
	Dim	The space dimensionality of this class	IfcDimensionCount	3	3	3

7.29.3. Interface Definitions

I_BoundingBox

7.30. Class IfcBoxedHalfSpace

7.30.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: This entity is a subtype of the half space solid which is trimmed by a surrounding rectangular box. The box has its edges parallel to the coordinate axes of the geometric coordinate system.

NOTE Corresponding STEP entity : *boxed_half_space,* please refer to ISO/IS 10303-42:1994, p. 185 for the final definition of the formal standard. The IFC class IfcBoundingBox is used for the definition of the enclosure, providing the same definition as *box_domain*.

7.30.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcHalfSpaceSolid
IfcBoxedHalfSpace

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Enclosure	The box which bounds the half space for computational purposes only	IfcBoundingBox	see type	see type	-

Formal Propositions

WR31	The BaseSurface defining the half space shall not be a bounded surface.

7.30.3. Interface Definitions

I_BoxedHalfSpace

7.31. Class IfcCartesianPoint

7.31.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: A point defined by its coordinates in a two or three dimensional rectangular Cartesian coordinate system, or in a two dimensional parameter space. The class is defined in a two or three dimensional space.

NOTE Corresponding STEP entity : *cartesian_point,* please refer to ISO/IS 10303-42:1994, p. 23 for the final definition of the formal standard. The derived attribute *Dim* has been added at this level and was therefore demoted from the *geometric_representation_item*. The *WR1* was added to constrain the usage of IfcCartesianPoint in the context of IFC Geometry. For the purpose of defining geometry in IFC only two and three dimensional Cartesian points are used. This complies to the Note in ISO/IS 10303-42:1994.

7.31.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
  IfcPoint
    IfcCartesianPoint

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Coordinates	The first, second, and third coordinate of the point location. If placed in a two or three dimensional rectangular Cartesian coordinate system, Coordinates[1] is the X coordinate, Coordinates[2] is the Y coordinate, and Coordinates[3] is the Z coordinate.	LIST [1:3] OF IfcLengthMeasure	see type	see type	(0.,0.,0.)
	Dim	The space dimensionality of this class, determined by the number of coordinates in the List of Coordinates.	IfcDimensionCount	2	3	3

Formal Propositions

WR31	Only two or three dimensional points shall be used for the purpose of defining geometry in this IFC Resource.

7.31.3. Interface Definitions

I_CartesianPoint

7.32. Class IfcCircle

7.32.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: An IfcCircle is defined by a radius and the location and orientation of the circle. Interpretation of data should be as follows:

C = SELF\IfcConic.Position.Location
X = SELF\IfcConic.Position.P[1]

y = SELF\IfcConic.Position.P[2]
z = SELF\IfcConic.Position.P[3]
R = Radius

and the circle is parameterized as

$$l(u) = \mathrm{C} + R((\cos u)\mathrm{x} + (\sin u)\mathrm{y})$$

The parameterization range is $0 \le u \le 2\pi$ (or $0 \le u \le 360$ degree). In the placement coordinate system defined above, the circle is the equation $C = 0$, where

$$C(x, y, z) = x^2 + y^2 - R^2$$

The positive sense of the circle at any point is in the tangent direction, **T**, to the curve at the point, where

$$\mathrm{T} = (-C_y, C_x, 0)$$

A circular arc is defined by using the IfcTrimmedCurve entity in conjunction with the IfcCircle entity as the *BasisCurve*.

NOTE Corresponding STEP entity: *circle,* please refer to ISO/IS 10303-42:1994, p. 38 for the final definition of the formal standard.

7.32.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcCurve
IfcConic
IfcCircle

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Radius	The radius of the circle, which shall be greater than zero	IfcPositiveLengthMeasure	see type	see type	1

7.32.3. Interface Definitions

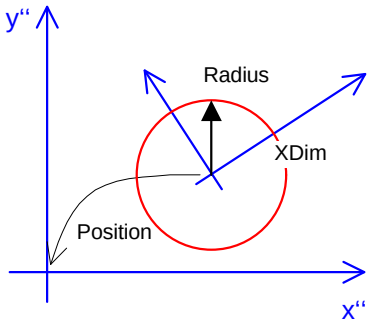
I_Circle

7.33. Class IfcCircleProfileDef

7.33.1. Class Semantic Definition

Definition from IAI: The IfcCircleProfileDef defines a circle as the profile definition used by the attribute driven geometric representation. It is given by its Radius attribute and placed within the local X'Y' plane.

ILLUSTRATION:



Position

The Position attribute of its supertype IfcAttDrivenProfileDef defines the 2D Placement of the Profile within the X''Y'' coordinate system, in which the derived bounded curve is defined.

Parameter

The location of the position coordinate system defines the center of the circle. The Radius attribute defines the radius of the circle.

7.33.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcAttDrivenProfileDef
IfcCircleProfileDef

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Radius	The radius of the circle.	IfcPositiveLengthMeasure	see type	see type	1
	CurveForSurface	Redefinition of the CurveForSurface defined in the supertype as being derived. A function is given that constructs an IfcTrimmedCurve out of the circle.	IfcTrimmedCurve	n/a	n/a	n/a

7.33.3. Interface Definitions

I_CircleProfileDef

7.34. Class IfcClosedShell

7.34.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: A closed shell is a shell of the dimensionality 2 which typically serves as a bound for a region in R^3. A closed shell has no boundary, and has non-zero finite extent. If the shell has a domain with coordinate space R^3, it divides that space into two connected regions, one finite and the other infinite. In this case, the topological normal of the shell is defined as being directed from the finite to the infinite region.

The shell is represented by a collection of faces. The domain of the shell, if present, contains all those faces, together with their bounds. Associated with each face in the shell is a logical value which indicates whether the face normal agrees with (TRUE) or is opposed to (FALSE) the shell normal. The logical value can be applied directly as a BOOLEAN attribute of an oriented face, or be defaulted to TRUE if the shell boundary attribute member is a face without the orientation attribute.

Definition from IAI: In the current IFC Release 2.0 only poly loops (*IfcPolyLoop*) are defined for *Bounds* of face bound (*IfcFaceBound*). This will allow for faceted B-rep only.

NOTE Corresponding STEP entity: *closed_shell,* please refer to ISO/IS 10303-42:1994, p.149 for the final definition of the formal standard.

7.34.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcTopologicalRepresentationItem
IfcConnectedFaceSet
IfcClosedShell

Attributes and Relationships

No attributes defined at this level.

Informal Propositions

IP31	Every edge shall be referenced exactly twice by the loops of the face.
IP32	Each oriented edge shall be unique.
IP33	No edge shall be referenced by more than two faces.
IP34	Distinct faces of the shell do not intersect, but may share edges or vertices.
IP35	Distinct edges do not intersect but may share vertices.
IP36	Each face reference shall be unique.
IP37	The loops of the shell shall not be a mixture of poly loop and other loop types. Note: this is given, since only poly loop is defined as face bound definition.
IP38	The closed shell shall be an oriented arcwise connected 2-manifold.
IP39	The Euler equation shall be satisfied. Note: Please refer to ISO/IS 10303-42:1994, p.149 for the equation.

7.34.3. Interface Definitions

I_ClosedShell

7.35. Class IfcCompositeCurve

7.35.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: An IfcCompositeCurve is a collection of curves joined end-to-end. The individual segments of the curve are themselves defined as IfcCompositeCurveSegment. The parameterization of the composite curve is an accumulation of the parametric ranges of the referenced bounded curves. The first segment is parameterized from 0 to l_1, and, for $i \geq 2$, the i^{th} segment is parameterized from where l_k is the parametric length (i.e., difference between maximum and minimum parameter values) of the curve underlying the k^{th} segment.

NOTE Corresponding STEP entity: *composite_curve,* please refer to ISO/IS 10303-42:1994, p. 56 for the final definition of the formal standard. The *WR2* is added to ensure consistent *Dim* at all segments.

7.35.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcCurve

IfcBoundedCurve
IfcCompositeCurve
Ifc2DCompositeCurve

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Segments	The component bounded curves, their transitions and senses. The transition attribute for the last segment defines the transition between the end of the last segment and the start of the first; this transition attribute may take the value discontinuous, which indicates an open curve.	LIST [1:?] OF IfcCompositeCurveSegment	1	N	1
	SelfIntersect	Indication of whether the curve intersects itself or not; this is for information only.	LOGICAL	see type	see type	FALSE
	NSegments	The number of component curves.	INTEGER	1	see type	1
	ClosedCurve	Indication whether the curve is closed or not; this is derived from the transition code of the last segment.	LOGICAL	see type	see type	TRUE

Formal Propositions

WR41	No transition code should be Discontinuous, except for the last code of an open curve.
WR42	Ensures, that all segments used in the curve have the same dimensionality.

Informal Propositions

IP41	The SameSense attribute of each segment correctly specifies the senses of the component curves. When traversed in the direction indicated by SameSense, the segments shall join end-to-end.

7.35.3. Interface Definitions

I_CompositeCurve

7.36. Class IfcCompositeCurveSegment

7.36.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: An IfcCompositeCurveSegment is a bounded curve together with transition information which is used to construct an IfcCompositeCurve.

NOTE Corresponding STEP entity: *composite_curve_segment*. The derived attribute *Dim* has been added at this level. Please refer to ISO/IS 10303-42:1994, p. 57 for the final definition of the formal standard.

7.36.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcCompositeCurveSegment

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Transition	The state of transition (i.e., geometric continuity from the last point of this segment to the first point of the next segment) in a composite curve.	IfcTransitionCode	Discontinuous	ContSameGradientSameCurvature	Continuous
	SameSense	An indicator of whether or not the sense of the segment agrees with, or opposes, that of the parent curve. If SameSense is false, the point with highest parameter value is taken as the first point of the segment.	BOOLEAN	see type	see type	TRUE
	ParentCurve	The bounded curve which defines the geometry of the segment.	IfcCurve	n/a	n/a	n/a
	Dim	The space dimensionality of this class, defined by the dimensionality of the first ParentCurve	IfcDimensionCount	2	3	3
INV	UsingCurves	The set of composite curves which use this composite curve segment as a segment. This set shall not be empty.	SET [1:?] OF IfcCompositeCurve	1	N	1

Formal Propositions

WR21	The parent curve shall be a bounded curve.

7.36.3. Interface Definitions

I_CompositeCurveSegment

7.37. Class IfcConic

7.37.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: An IfcConic is a planar curve which could be produced by intersecting a plane with a cone. A conic is defined in terms of its intrinsic geometric properties rather than being described in terms of other geometry. A conic class always has a Placement Coordinate System defined by a two or three dimensional placement. The parametric representation is defined in terms of this Placement Coordinate System.

NOTE Corresponding STEP entity: *conic,* only the following subtypes have been incorporated into IFC 1.0, 1.5 & 2.0: *circle* as IfcCircle, *ellipse* as IfcEllipse. The derived attribute *Dim* has been added at this level and was therefore demoted from the *geometric_representation_item*. Please refer to ISO/IS 10303-42:1994, p. 38 for the final definition of the formal standard.

7.37.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
  IfcCurve
    IfcConic
      IfcCircle
      IfcEllipse

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Position	The location and orientation of the conic.	IfcAxis2Placement	n/a	n/a	n/a

7.37.3. Interface Definitions

I_Conic

7.38. Class IfcConnectedFaceSet

7.38.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: An IfcConnectedFaceSet is a set of IfcFace such that the domain of faces together with their bounding edges and vertices is connected.

NOTE Corresponding STEP entity: *connected_face_set*, only the subtype *closed_shell* is included as IfcClosedShell. Please refer to ISO/IS 10303-42:1994, p. 144 for the final definition of the formal standard.

ISSUE: See issue I-227 for changes made in IFC Release 1.5.

7.38.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcTopologicalRepresentationItem
IfcConnectedFaceSet
IfcClosedShell

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	CfsFaces	The set of faces arcwise connected along common edges or vertices.	SET [1:?] OF IfcFace	1	N	1

Informal Propositions

IP21	The union of the domains of the faces and their bounding loops shall be arcwise connected.

7.38.3. Interface Definitions

I_ConnectedFaceSet

7.39. Class IfcCsgSolid

7.39.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: A solid represented as a CSG model is defined by a collection of so-called primitive solids, combined using regularized Boolean operations. The allowed operations are intersection, union, and difference. As a special case a CSG solid can also consists of a single CSG primitive (not in IFC1.5). A CSG solid requires two kinds of information for its complete definition: geometric and structural:

- The geometric information is conveyed by solid models. These typically primitive volumes such as cylinders, wedges and extrusions, but can include general B-Rep models. There can also be solid replicas (not in IFC1.5) and half space solids.
- The structural information is in a tree (strictly an acyclic directed graph) of Boolean result and CSG solids, which represent a 'recipe' for building the solid. The terminal nodes are the geometric primitives and other solids. Every CSG solid has precisely one Boolean result associated with it which is the root of the tree that defines the solid. (There may be further Boolean results within the tree as operands). The significance of a CSG solid entity is that the solid defined by the associated tree is thus identified as a significant object itself, and in this way it is distinguished from other Boolean result entities representing intermediate results during the construction process.

Definition from IAI: The following primitive volumes can be parts of the CSG tree: solid models, i.e. faceted B-Rep (IfcFacetedBrep, IfcFacetedBrepWithVoids) or swept area solid (IfcExtrudedAreaSolid, IfcRevolvedAreaSolid). CSG primitives are out of scope for current IFC Release. The use of attribute driven extruded solids and segments, and attribute driven revolved solids and segments within a Boolean operation for the CSG tree is not foreseen for the current IFC Release.

NOTE Corresponding STEP entity: *csg_solid,* please refer to ISO/IS 10303-42:1994, p.174 for the final definition of the formal standard.

ISSUE: See I-330 for changes made in IFC Release 1.5.1

7.39.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcSolidModel
IfcCsgSolid

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	TreeRootExpression	Boolean expression of regularized operators describing the solid. The root of the tree of Boolean expressions is given explicitly as an IfcBooleanResult (the only item in the Select IfcCsgSelect).	IfcCsgSelect	1	1	1

7.39.3. Interface Definitions

I_CsgSolid

7.40. Class IfcCurve

7.40.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: A curve can be envisioned as the path of a point moving in its coordinate space.

NOTE Corresponding STEP entity: *curve*, only the following subtypes have been incorporated into IFC 1.5: *line* as IfcLine, *conic* as IfcConic, *bounded_curve* as IfcBoundedCurve. Please refer to ISO/IS 10303-42:1994, p. 37 for the final definition of the formal standard.

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

7.40.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcCurve
IfcBoundedCurve
IfcConic
IfcLine

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Dim	The space dimensionality of this abstract class, defined differently for all subtypes, i.e. for IfcLine, IfcConic and IfcBoundedCurve.	IfcDimensionCount			

Informal Propositions

IP21	A curve shall be arcwise connected.
IP22	A curve shall have an arc length greater than zero.

7.40.3. Interface Definitions

I_Curve

7.41. Class IfcCurveBoundedPlane

7.41.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: The curve bounded surface is a parametric surface with curved boundaries defined by one or more boundary curves. The bounded surface is defined to be the portion of the basis surface in the direction of ***N x T*** from any point on the boundary, where **N** is the surface normal and **T** the boundary curve tangent vector at this point. The region so defined shall be arcwise connected.

Definition from IAI: The IfcCurveBoundedPlane is a specialized bounded surface class that deals only with bounding basis plane surfaces. The definition varies from STEP as outer and inner boundaries are separated attributes and reference the special IFC type Ifc2DCompositeCurve. Only basis surfaces of type IfcPlane are allowed, and the *implicit_outer* attribute has not been incorporated, since only unbounded surfaces are used as basis surface.

NOTE Corresponding STEP entity *curve_bounded_surface* has been changed to meet the specific requirements of an easy representation of curve bounded planes. Only curve bounded planes are allowed in swept area solid, therefore this entity meets the specific requirements of the swept area solid with an easy implementation.

ISSUE: See issue I-225 for changes made in IFC Release 1.5.
See issue I-333 for changes made in IFC Release 1.5.1

7.41.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcSurface
IfcCurveBoundedPlane

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	BasisSurface	The surface to be bound	IfcPlane	n/a	n/a	n/a
	OuterBoundary	The outer boundary of the surface.	Ifc2DCompositeCurve	n/a	n/a	n/a
	InnerBoundaries	An optional set of inner boundaries. They shall not intersect each other or the outer boundary.	SET [0:?] OF Ifc2DCompositeCurve	0	N	empty
	Dim	The space dimensionality of this class, defined by the dimensionality of the basis surface.	IfcDimensionCount	3	3	3

7.41.3. Interface Definitions

I_CurveBoundedPlane

7.42. Class IfcDirection

7.42.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: This entity defines a general direction vector in two or three dimensional space. The actual magnitudes of the components have no effect upon the direction being defined, only the ratios X:Y:Z or X:Y are significant.

NOTE Corresponding STEP entity: *direction.* The derived attribute *Dim* has been added at this level and was therefore demoted from the *geometric_representation_item*. Please refer to ISO/IS 10303-42:1994, p. 26 for the final definition of the formal standard.

7.42.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcDirection

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	DirectionRatios	The components in the direction of X axis (DirectionRatios[1]), of Y axis (DirectionRatios[2]), and of Z axis (DirectionRatios[3])	LIST [2:3] OF REAL	2	3	3
	Dim	The space dimensionality of this class, defined by the number of real in the list of DirectionRatios	IfcDimensionCount	2	3	2

Formal Propositions

WR21	The magnitude of the direction vector shall be greater than zero.

7.42.3. Interface Definitions

I_Direction

7.43. Class IfcEdge

7.43.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: An edge is the topological construct corresponding to the connection of two vertices. More abstractly, it may stand for a logical relationship between two vertices. The domain of an edge, if present (not in current IFC release), is a finite, non-self-intersecting open curve in R^M, that is, a connected 1-dimensional manifold. The bounds of an edge are two vertices, which need not be distinct. The edge is oriented by choosing its traversal direction to run from the first to the second vertex. If the two vertices are the same, the edge is a self loop. The domain of the edge does not include its bounds, and $0 \leq \Xi \leq \infty$.

An edge is a graph, so its multiplicity M and graph genus G^e may be determined by the graph traversal algorithm. Since $M = E = 1$, the Euler equation (1) reduces in the case to

$$V - \left(2 - G^e\right) = 0$$

where V = 1 or 2, and G^e = 1 or 0.

Specifically, the topological edge defining data shall satisfy:

- an edge has two vertices
$$\left|E[V]\right| = 2$$
- the vertices need not be distinct
$$1 \leq \left|E\{V\}\right| \leq 2$$
- Equation (2) shall hold.
$$\left|E\{V\}\right| - 2 + G^e = 0$$

NOTE Corresponding STEP entity: *edge.* Please refer to ISO/IS 10303-42:1994, p. 130 for the final definition of the formal standard.

History

New Entity in IFC Release 2.0

7.43.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcTopologicalRepresentationItem
IfcEdge
IfcOrientedEdge

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	EdgeStart	Start point (vertex) of the edge.	IfcVertex	n/a	n/a	n/a
	EdgeEnd	End point (vertex) of the edge. The same vertex can be used for both EdgeStart and EdgeEnd.	IfcVertex	n/a	n/a	n/a

Informal Propositions

IP21	The edge has dimensionality 1.
IP22	The extent of an edge dhall be finite and nonzero.

7.43.3. Interface Definitions

I_Edge

7.44. Class IfcElementarySurface

7.44.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: An IfcElementarySurface is a simple analytic surface with defined parametric representation.

NOTE Corresponding STEP entity: *elementary_surface.* Only the subtype *plane* is incorporated as IfcPlane. The derived attribute *Dim* has been added at this level and was therefore demoted from the *geometric_representation_item*. Please refer to ISO/IS 10303-42:1994, p. 69 for the final definition of the formal standard.

7.44.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcSurface
IfcElementarySurface
IfcPlane

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Position	The position and orientation of the surface. This attribute is used in the definition of the parameterization of the surface.	IfcAxis2Placement3D	n/a	n/a	n/a
	Dim	The space dimensionality of this class, derived from the dimensionality of the Position	IfcDimensionCount	3	3	3

7.44.3. Interface Definitions

I_ElementarySurface

7.45. Class IfcEllipse

7.45.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: An IfcEllipse is a conic section defined by the lengths of the semi-major and semi-minor diameters and the position (center or mid point of the line joining the foci) and orientation of the curve. Interpretation of the data shall be as follows:

C = SELF\IfcConic.Position.Location
x = SELF\IfcConic.Position.P[1]
y = SELF\IfcConic.Position.P[2]
z = SELF\IfcConic.Position.P[3]
R_1 = SemiAxis1
R_2 = SemiAxis2

and the ellipse is parameterized as:

$$l(u) = \mathrm{C} + (R_1 \cos u)\mathrm{x} + (R_2 \sin u)\mathrm{y}$$

The parameterization range is $0 \le u \le 2\pi$ (or $0 \le u \le 360$ degree). In the placement coordinate system defined above, the ellipse is the equation $C = 0$, where

$$C(x, y, z) = x^2 / R_1^2 + y^2 / R_2^2 - 1$$

The positive sense of the ellipse at any point is in the tangent direction, T, to the curve at the point, where

$$\mathrm{T} = (-C_y, C_x, 0)$$

The inherited *Position.Location* from IfcConic is the center of the IfcEllipse, and the inherited *Position.P[1]* from IfcConic the direction of the *SemiAxis1*.

NOTE Corresponding STEP entity: *ellipse.* Please refer to ISO/IS 10303-42:1994, p. 39 for the final definition of the formal standard.

7.45.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
  IfcCurve
    IfcConic
      IfcEllipse

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	SemiAxis1	The first radius of the ellipse which shall be positive. Placement.Axes[1] gives the direction of the SemiAxis1	IfcPositiveLengthMeasure	0	see type	1
	SemiAxis2	The second radius of the ellipse which shall be positive.	IfcPositiveLengthMeasure	0	see type	1

7.45.3. Interface Definitions

I_Ellipse

7.46. Class IfcExtrudedAreaSolid

7.46.1. Class Semantic Definition

Definition from IAI: The IfcExtrudedAreaSolid is defined by sweeping a planar bounded plane. The direction of the extrusion is given by the ExtrudedDirection attribute and the length of the extrusion is given by the Depth attribute. The only allowed area type to be swept is an IfcCurveBoundedPlane, given by the inherited SweptArea attribute from the IfcSweptAreaSolid. If the IfcCurveBoundedPlane has inner boundaries, i.e. holes defined, then those holes shall be swept into holes of the solid.

NOTE Corresponding STEP entity: *extruded_area_solid.* Please refer to ISO/IS 10303-42:1994, p. 183 for the final definition of the formal standard. NOTE the data type of the inherited SweptArea attribute is different, i.e. of type IfcCurveBoundedPlane. This complies to *WR1* at the supertype *swept_area_solid*, defining that only planar bounded surfaces are allowed for swept area solids.

ISSUE: See issue I-019 for changes made in IFC Release 1.5.

7.46.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcSolidModel
IfcSweptAreaSolid
IfcExtrudedAreaSolid
IfcAttDrivenExtrudedSegment

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	ExtrudedDirection	The direction in which the surface is to be swept.	IfcDirection	n/a	n/a	equal to normal
	Depth	The distance the surface is to be swept	IfcPositiveLengthMeasure	0	see type	1

Formal Propositions

WR41	The ExtrudedDirection shall not be perpendicular to the normal of the plane surface

7.46.3. Interface Definitions

I_ExtrudedAreaSolid

7.47. Class IfcFace

7.47.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: A face is a topological entity of dimensionality 2 corresponding to the intuitive notion of a piece of surface bounded by loops. Its domain, if present, is an oriented, connected, finite 2-manifold in R^m. A face domain shall not have handles but it may have holes, each hole bounded by a loop. The domain of the underlying geometry of the face, if present, does not contain its bounds, and $0 < X < \infty$.

A face is represented by its bounding loops, which are defined as face bounds. A face has a topological normal **n** and the tangent to a loop is **t**. For a loop bounding a face with defined geometry, the cross product **n x t** points toward the interior of the face. That is, each loop runs counter-clockwise around the face when viewed from above, if we consider the normal n to point up. With each loop is associated a BOOLEAN flag to signify whether the loop direction is oriented with respect to the face normal (TRUE) or should be reversed (FALSE).

A face shall have at least one bound, and the loops shall not intersect. One loop is optionally distinguished as the *outer* loop of the face. If so, it establishes a preferred way of embedding the face domain in the plane, in which the other bounding loops of the face are *inside* the outer bound. Because the face domain is arcwise connected, no inner loop will contain any other loop. This is true regardless of which embedding in the plane is chosen.

NOTE Corresponding STEP entity: *face.* No subtypes of face have been incorporated into this IFC Release. Please refer to ISO/IS 10303-42:1994, p. 140 for the final definition of the formal standard. The *WR1* has not been incorporated, since it is always satisfied, due to the fact that only poly loops exist for face bounds.

7.47.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcTopologicalRepresentationItem

IfcFace

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Bounds	Boundaries of the face.	SET [1:?] OF IfcFaceBound	1	N	1

Formal Propositions

WR21	At most one of the bounds shall be of the type IfcFaceOuterBound

Informal Propositions

IP21	No edge shall be referenced by the face more than twice,
IP22	Distinct face bounds of the face shall have no common vertices.
IP23	If geometry is present, distinct loops of the same face shall not intersect.
IP24	The face shall satisfy the Euler Equation: (number of vertices) - (number of edges) - (number of loops) + (sum of genus for loops) = 0.

7.47.3. Interface Definitions

I_Face

7.48. Class IfcFaceBound

7.48.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: A face bound is a loop which is intended to be used for bounding a face.

NOTE Corresponding STEP entity: *face_bound.* Please refer to ISO/IS 10303-42:1994, p. 139 for the final definition of the formal standard.

7.48.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcTopologicalRepresentationItem
IfcFaceBound
IfcFaceOuterBound

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Bound	The loop which will be used as a face boundary	IfcPolyLoop	n/a	n/a	n/a
	Orientation	This indicated whether (TRUE) or not (FALSE) the loop has the same sense when used to bound the face as when first defined. If sense is FALSE the senses of all its component oriented edges are implicitly reversed when used in the face.	BOOLEAN	see type	see type	TRUE

7.48.3. Interface Definitions

I_FaceBound

7.49. Class IfcFaceOuterBound

7.49.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: A face outer bound is a special subtype of face bound which carries the additional semantics of defining an outer boundary on the face. No more than one boundary of a face shall be of this type.

NOTE Corresponding STEP entity: *face_outer_bound.* Please refer to ISO/IS 10303-42:1994, p. 139 for the final definition of the formal standard.

7.49.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcTopologicalRepresentationItem
IfcFaceBound
IfcFaceOuterBound

Attributes and Relationships

No attributes defined at this level.

7.49.3. Interface Definitions

I_FaceOuterBound

7.50. Class IfcFacetedBrep

7.50.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: An IfcFacetedBrep is a simple form of boundary representation model in which all faces are planar and all edges are straight lines. Unlike the B-rep model, edges and vertices are not represented explicitly in the model but are implicitly available through the IfcPolyLoop entity. A faceted B-rep has to meet the same topological constraints as the manifold solid Brep.

NOTE Corresponding STEP entity: *faceted_brep*. Please refer to ISO/IS 10303-42:1994, p. 173 for the final definition of the formal standard. NOTE In IFC Release 1.5 faceted B-rep with voids is represented by an own subtype and not defined via an implicit ANDOR supertype constraint as in ISO/IS 10303-42:1994. This change has been made due to the fact, that only ONEOF supertype constraint is allowed within the IFC object model.

ISSUE: See issue I-019 for changes made in IFC Release 1.5.

7.50.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem

IfcSolidModel
IfcManifoldSolidBrep
IfcFacetedBrep

Attributes and Relationships

No attributes defined at this level.

Informal Propositions

IP41	All the bounding loops of all the faces of all the shells in the IfcFacetedBrep shall be of type IfcPolyLoop.

7.50.3. Interface Definitions

I_FacetedBrep

7.51. Class IfcFacetedBrepWithVoids

7.51.1. Class Semantic Definition

Definition from IAI: The IfcFacetedBrepWithVoids is a specialization of a faceted B-rep which contains one or more voids in its interior. The voids are represented as closed shells which are defined so that the shell normal point into the void.

NOTE Corresponding STEP entity: *brep_with_voids* (see note above). Please refer to ISO/IS 10303-42:1994, p. 173 for the final definition of the formal standard. NOTE In IFC faceted B-rep with voids is represented by this subtype IfcFacetedBrepWithVoids and not defined via an implicit ANDOR supertype constraint as in ISO/IS 10303-42:1994 between an instance of *faceted_brep* AND *brep_with_voids*. This change has been made due to the fact, that only ONEOF supertype constraint is allowed within the IFC object model.

7.51.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcSolidModel
IfcManifoldSolidBrep
IfcFacetedBrepWithVoids

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Voids	Set of closed shells defining voids within the solid	SET [1:?] OF IfcClosedShell	1	N	1

Informal Propositions

IP41	Each void shell shall be disjoint from the outer shell and from every other void shell
IP42	Each void shell shall be enclosed within the outer shell but not within any other void shell. In particular the outer shell is not in the set of void shells
IP43	Each shell in the IfcManifoldSolidBrep shall be referenced only once.
IP44	All the bounding loops of all the faces of all the shells in the IfcFacetedBrep shall be of type IfcPolyLoop.

7.51.3. Interface Definitions

I_FacetedBrepWithVoids

7.52. Class IfcGeometricRepresentationItem

7.52.1. Class Semantic Definition

Definition from ISO/CD 10303-43:1992: An geometric representation item is a representation item that has the additional meaning of having geometric position or orientation or both. This meaning is present by virtue of:

- being a Cartesian point of a direction
- referencing directly a Cartesian point or direction
- referencing indirectly a Cartesian point or direction

An indirect reference to a Cartesian point or direction means that a given geometric item references the Cartesian point or direction through one or more intervening geometry or topology items.

Definition from IAI: The derivation of the dimensionality of the IfcGeometricRepresentationItem is different to STEP, there is a specific derived attribute at each class that defines the dimensionality, whereas STEP does it for the *representation_context* and requires that all *geometric_representation_item* have the same dimensionality therein.

IfcGeometricRepresentationItem is the generalization of both, explicit geometric representation items and attribute driven representation items. Attribute Driven geometric representation was formerly known as implicit geometry in IFC, it was renamed to prevent naming conflicts with the usage of the term "implicit" in analytic geometry.

The attribute driven geometric representation makes use of two principles:

- Use a set of predefined geometry primitives, i.e. parameterize a set of geometry primitives widely supported in the industry
- Use of three geometry creation methods for defining geometry implicitly:
- extrusion: surfaces created through extrusion of a profile along a path
- revolution: surfaces created through rotating a profile about an axis, given by a circular arc
- composition: solids or surfaces created through the composition of multiple sub-parts

NOTE Corresponding STEP entity: *geometric_representation_item*. Please refer to ISO/IS 10303-42:1994, p. 22 for the final definition of the formal standard. The following changes have been made: It does not inherit from ISO/IS 10303-43:1994 entity *representation_item*. The derived attribute *Dim* is demoted to the appropriate subtypes. The *WR1* has not been incorporated. Not all subtypes that are in ISO/IS 10303-42:1994 have been added to the IFC Release 1.5 & 2.0.

ISSUE: See issue GI-003, I-180, I-182 for changes made in IFC Release 1.5.

7.52.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcBooleanResult
IfcBoundingBox
IfcCompositeCurveSegment
IfcCurve
IfcDirection
IfcHalfSpaceSolid
IfcPlacement
IfcPoint
IfcPolyLoop

IfcSolidModel
IfcSurface
IfcVector

Attributes and Relationships

No attributes defined at this level.

7.52.3. Interface Definitions

I_GeometricRepresentationItem

7.53. Class IfcHalfSpaceSolid

7.53.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: A half space solid is defined by the half space which is the regular subset of the domain which lies on one side of an unbounded surface. The side of the surface which is in the half space is determined by the surface normal and the agreement flag. If the agreement flag is TRUE, then the subset is the one the normal points away from. If the agreement flag is FALSE, then the subset is the one the normal points into.

For a valid half space solid the surface shall divide the domain into exactly two subsets. Also, within the domain the surface shall be manifold and all surface normals shall point into the same subset.

NOTE Corresponding STEP entity: *half_space_solid*. Please refer to ISO/IS 10303-42:1994, p. 185 for the final definition of the formal standard. The derived attribute *Dim* has been added at this level and was therefore demoted from the *geometric_representation_item*.

7.53.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcHalfSpaceSolid
IfcBoxedHalfSpace

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	BaseSurface	Surface defining side of half space	IfcSurface	n/a	n/a	n/a
	AgreementFlag	The agreement flag is TRUE if the normal to the BaseSurface points away from the material of the IfcHalfSpaceSolid. Otherwise it is FALSE	BOOLEAN	see type	see type	TRUE
	Dim	The space dimensionality of this class, always 3	IfcDimensionCount	3	3	3

7.53.3. Interface Definitions

I_HalfSpaceSolid

7.54. Class IfcLine

7.54.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: A line is an unbounded curve with constant tangent direction. A line is defined by a point and a direction. The positive direction of the line is in the direction of the *Dir* vector.

The line is parameterized as follows:

P = *Pnt*
V = *Dir*
$\lambda(u)$ = **P** + u**V**

and the parametric range is $-\infty < u < \infty$.

NOTE Corresponding STEP entity: *line*. Please refer to ISO/IS 10303-42:1994, p. 37 for the final definition of the formal standard. The derived attribute *Dim* has been added at this level and was therefore demoted from the *geometric_representation_item*.

7.54.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
  IfcCurve
    IfcLine

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Pnt	The location of the line	IfcCartesianPoint	n/a	n/a	n/a
	Dir	The direction of the line, the magnitude and units of Dir affect the parameterization of the line.	IfcVector	n/a	n/a	n/a

Formal Propositions

WR31	The dimensionality of the location (IfcCartesianPoint) shall be the same as of the direction (IfcVector)

7.54.3. Interface Definitions

I_Line

7.55. Class IfcManifoldSolidBrep

7.55.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: A manifold solid B-rep is a finite, arcwise connected volume bounded by one or more surfaces, each of which is a connected, oriented, finite, closed 2-manifold. There is no restriction on the genius of the volume, nor on the number of voids within the volume.

The Boundary Representation (B-rep) of a manifold solid utilizes a graph of edges and vertices embedded in a connected, oriented, finite, closed two manifold surface. The embedded graph divides the surface into arcwise connected areas known as faces. The edges and vertices, therefore, form the boundaries of the face and the domain of a face does not include its boundaries. The embedded graph may be disconnected and may be a pseudo graph. The graph is labeled; that is, each entity in the graph has a unique identity. The geometric surface definition used to specify the geometry of a face shall be 2-manifold embeddable in the

plane within the domain of the face. In other words, it shall be connected, oriented, finite, non-self-intersecting, and of surface genus 0.

Faces do not intersect except along their boundaries. Each edge along the boundary of a face is shared by at most one other face in the assemblage. The assemblage of edges in the B-rep do not intersect except at their boundaries (i.e., vertices). The geometry curve definition used to specify the geometry of an edge shall be arcwise connected and shall not self intersect or overlap within the domain of the edge. The geometry of an edge shall be consistent with the geometry of the faces of which it forms a partial bound. The geometry used to define a vertex shall be consistent with the geometry of the faces and edges of which it forms a partial bound.

A B-rep is represented by one or more closed shells which shall be disjoint. One shell, the outer, shall completely enclose all the other shells and no other shell may enclose a shell. The facility to define a B-rep with one or more internal voids is provided by a subtype. The following version of the Euler formula shall be satisfied:

$$x_{ms} = V - E + 2F - L_l - 2\left(S - G^s\right) = 0$$

where *V, E, F,* L_l and *S* are the numbers of unique vertices, edges, faces, loop uses and shells in the model and G^s is the sum of the genus of the shells. (*NOTE should be fractal type setting*).

Definition from IAI: In the IFC Release 1.5 all instances of type IfcManifoldSolidBrep shall be faceted B-rep, using only IfcPolyLoop for the bounds of IfcFaceBound.

NOTE Corresponding STEP entity: *manifold_solid_brep.* Please refer to ISO/IS 10303-42:1994, p. 170 for the final definition of the formal standard. Since only faceted B-rep (with and without voids) is in scope of IFC Release 1.5 & 2.0 the IfcManifoldSolidBrep is defined as ABSTRACT supertype to prevent it from direct instantiation.

7.55.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcSolidModel
IfcManifoldSolidBrep
IfcFacetedBrep
IfcFacetedBrepWithVoids

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Outer	A closed shell defining the exterior boundary of the solid. The shell normal shall point away from the interior of the solid	IfcClosedShell	n/a	n/a	n/a

7.55.3. Interface Definitions

I_ManifoldSolidBrep

7.56. Class IfcOrientedEdge

7.56.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: An oriented edge is an edge constructed from another edge and contains a BOOLEAN direction flag to indicate whether or not the orientation of the constructed edge agrees

with the orientation of the original edge. Except for perhaps orientation, the oriented edge is equivalent to the original edge.

NOTE Corresponding STEP entity: *oriented_edge.* Please refer to ISO/IS 10303-42:1994, p. 133 for the final definition of the formal standard.

History

New Entity in IFC Release 2.0

7.56.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcTopologicalRepresentationItem
IfcEdge
IfcOrientedEdge

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	EdgeElement	Edge entity used to construct this oriented edge.	IfcEdge			
	Orientation	BOOLEAN, If TRUE the topological orientation as used coincides with the orientation from start vertex to end vertex of the edge element. If FALSE otherwise.	BOOLEAN	FALSE	TRUE	n/a
	EdgeStart	The start vertex of the oriented edge. It derives from the vertices of the edge element after taking account of the orientation.	IfcVertex	n/a	n/a	n/a
	EdgeEnd	The end vertex of the oriented edge. It derives from the vertices of the edge element after taking account of the orientation.	IfcVertex	n/a	n/a	n/a

Formal Propositions

WR31	The edge element shall not be an oriented edge.

7.56.3. Interface Definitions

I_OrientedEdge

7.57. Class IfcPath

7.57.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: A path is a topological entity consisting of an ordered collection of oriented edges, such that the edge start vertex of each edge coincides with the edge end of its predecessor. The path is ordered from the edge start of the first oriented edge to the edge end of the last edge. The BOOLEAN value sense in the oriented edge indicates whether the edge direction agrees with the direction of the path (TRUE) or is the opposite direction (FALSE).

An individual edge can only be referenced once by an individual path. An edge can be referenced by multiple paths. An edge can exist independently of a path.

NOTE Corresponding STEP entity: *path.* Please refer to ISO/IS 10303-42:1994, p. 133 for the final definition of the formal standard.

History

New Entity in IFC Release 2.0

7.57.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcTopologicalRepresentationItem
IfcPath

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	EdgeList	The list of oriented edges which are concatenated together to form this path.	LIST [1:?] OF IfcOrientedEdge	1	N	1

Formal Propositions

WR21	The end vertex of each edge shall be the same as the start vertex of its successor.

Informal Propositions

IP21	The path has dimensionality 1.
IP22	A path is arcwise connected.
IP23	The edges of the path do not intersect except at common vertices.
IP24	A path has a finite, non-zero extent

7.57.3. Interface Definitions

I_Path

7.58. Class IfcPlacement

7.58.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: A placement entity defines the local environment for the definition of a geometry item. It locates the item to be defined and, in the case of the axis placement subtypes, gives its orientation.

NOTE Corresponding STEP entity: *placement,* in contrary to IFC Release 1.0 the IfcPlacement definition in IFC Release 1.5 strictly follows the STEP definition. Please refer to ISO/IS 10303-42:1994, p. 27 for the final definition of the formal standard.

7.58.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcPlacement
IfcAxis1Placement
IfcAxis2Placement2D
IfcAxis2Placement3D

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Location	The geometric position of a reference point, such as the center of a circle, of the item to be located.	IfcCartesianPoint	n/a	n/a	n/a
	Dim	The space dimensionality of this class, derived from the dimensionality of the location.	IfcDimensionCount	2	3	3

7.58.3. Interface Definitions

I_Placement

7.59. Class IfcPlane

7.59.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: An IfcPlane is an unbounded surface with a constant normal. An IfcPlane is defined by a point on the plane and the normal direction to the plane. The data is to be interpreted as follows:

C = SELF\IfcElementarySurface.Position.Location
x = SELF\IfcElementarySurface.Position.P[1]
y = SELF\IfcElementarySurface.Position.P[2]
z = SELF\IfcElementarySurface.Position.P[3] => normal to plane

and the surface is parameterized as:

$$s(u,v) = C + \mathrm{x}\,u + \mathrm{y}\,v$$

where the parametric range is $-\infty < u,v < \infty$. In the above parameterization the length unit for the unit vectors **x** and **y** is derived from the context of the plane.

NOTE Corresponding STEP entity: *plane.* Please refer to ISO/IS 10303-42:1994, p. 69 for the final definition of the formal standard.

7.59.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
  IfcSurface
    IfcElementarySurface
      IfcPlane

Attributes and Relationships

No attributes defined at this level.

7.59.3. Interface Definitions

I_Plane

7.60. Class IfcPoint

7.60.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: An IfcPoint is a location in some real Cartesian coordinate space R^m, for $m = 2$ or $m = 3$.

NOTE Corresponding STEP entity: *point.* Only the subtype *cartesian_point* has been incorporated as IfcCartesianPoint. Please refer to ISO/IS 10303-42:1994, p. 22 for the final definition of the formal standard.

ISSUE: See issue I-224 for changes made in IFC Release 1.5.

7.60.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcPoint
IfcCartesianPoint

Attributes and Relationships

No attributes defined at this level.

7.60.3. Interface Definitions

I_Point

7.61. Class IfcPolyLoop

7.61.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: An IfcPolyLoop is a loop with straight edges bounding a planar region in space. An IfcPolyLoop is a loop of genus 1 where the loop is represented by an ordered coplanar collection of points forming the vertices of the loop. The loop is composed of straight line segments joining a point in the collection to the succeeding point in the collection. The closing segment is from the last to the first point in the collection. The direction of the loop is in the direction of the line segments.

NOTE Corresponding STEP entity: *poly_loop*, in contrary to STEP the IfcPolyLoop only inherits from IfcGeometricRepresentationItem and therefore does not utilize multiple inheritance. The derived attribute *Dim* has been added at this level and was therefore demoted from the *geometric_representation_item*. Please refer to ISO/IS 10303-42:1994, p. 138 for the final definition of the formal standard.

7.61.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcPolyLoop

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Polygon	List of points defining the loop. There are no repeated points in the list. NOTE: All the points in the Polygon defining the polyloop shall be coplanar.	LIST [3:?] OF IfcCartesianPoint	3	N	3
	Dim	The space dimensionality of this class, derived from the dimensionality of the first point.	IfcDimensionCount	2	3	3

Formal Propositions

WR21	The space dimensionality of all Points shall be the same

Informal Propositions

IP21	All points in the polygon defining the poly loop shall be coplanar.

7.61.3. Interface Definitions

I_PolyLoop

7.62. Class IfcPolyline

7.62.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: An IfcPolyline is a bounded curve of n -1 linear segments, defined by a list of *n* points, P_1, P_2, … P_n.

The curve is parameterized as follows:

$$l(u) = \mathrm{P}_i(i-u) + \mathrm{P}_{i+1}(u+1-i)$$

for 1 £ *i* £ *n*-1, where *i-1* £ *u* £ *i* and with parametric range of *0* £ *u* £ *n-1.*

NOTE Corresponding STEP entity: *polyline.* The *WR1* is added to ensure consistent *Dim* of all points. Please refer to ISO/IS 10303-42:1994, p. 45 for the final definition of the formal standard.

7.62.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
  IfcCurve
    IfcBoundedCurve
      IfcPolyline

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Points	The points defining the polyline	LIST [2:?] OF IfcCartesianPoint	2	N	2

Formal Propositions

WR41	The space dimensionality of all Points shall be the same

7.62.3. Interface Definitions

I_Polyline

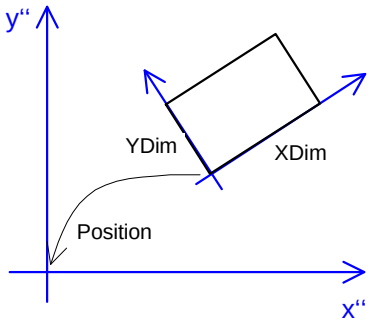
7.63. Class IfcRectangleProfileDef

7.63.1. Class Semantic Definition

Definition from IAI: The IfcRectangleProfileDef defines a rectangle as the profile definition used by the attribute driven geometric representation. It is given by its X extent and its Y extent, both defined in its local 2D coordinate system.

ISSUE: See issue I-035 for changes made in IFC Release 1.5.

ILLUSTRATION:



Position

The Position attribute of its supertype IfcAttDrivenProfileDef defines the 2D Placement of the Profile within the X''Y'' coordinate system, in which the derived bounded curve is defined.

Parameter

The IfcRectangleProfileDef is defined within the position coordinate system, where the XDim defines the length measure along the positive x-axis and the YDim defines the length measure along the positive y-axis.

7.63.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcAttDrivenProfileDef
IfcRectangleProfileDef

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	XDim	The extend on the implicit x-axis of the rectangle	IfcPositiveLengthMeasure	see type	see type	1
	YDim		IfcPositiveLengthMeasure			
	CurveForSurface	Redefinition of the CurveForSurface defined in the supertype as being derived. A function is given that constructs an IfcPolyline out of the rectangle.	IfcPolyline	n/a	n/a	n/a

7.63.3. Interface Definitions

I_RectangleProfileDef

7.64. Class IfcRevolvedAreaSolid

7.64.1. Class Semantic Definition

Definition from IAI: An IfcRevolvedAreaSolid is a solid created by revolving a planar bounded surface about an axis. Both, the *Axis* and planar bounded surface, *SweptArea*, inherited by the supertype IfcSweptAreaSolid, shall be in the same plane and the Axis shall not intersect the interior of *SweptArea*. If the *SweptArea* has inner boundaries, i.e. holes defined, then those holes shall be swept into holes of the solid.

NOTE Corresponding STEP entity: *revolved_area_solid.* Please refer to ISO/IS 10303-42:1994, p. 184 for the final definition of the formal standard. NOTE the data type of the inherited SweptArea attribute is different, i.e. of type IfcCurveBoundedPlane. This complies to *WR1* at the supertype *swept_area_solid*, defining that only planar bounded surfaces are allowed for swept area solids.

7.64.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcSolidModel
IfcSweptAreaSolid
IfcRevolvedAreaSolid
IfcAttDrivenRevolvedSegment

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Axis	Axis about which revolution will take place	IfcAxis1Placement	n/a	n/a	n/a
	Angle	Angle through which the sweep will be made. This Angle is measured from the plane of the sweep face.	IfcPlaneAngleMeasure	0	<2p	p/2
	AxisLine	The line of the axis of revolution	IfcLine	n/a	n/a	n/a

Informal Propositions

IP41	The Axis Line shall lie in the plane of the Swept Area (as defined at supertype IfcSweptAreaSolid).
IP42	The Axis Line shall not intersect the interior of the Swept Area (as defined at supertype IfcSweptAreaSolid).
IP43	The Angle shall be between 0° and 360°, or 0 and 2p (depending on the unit type for Plane Angle Measure).

7.64.3. Interface Definitions

I_RevolvedAreaSolid

7.65. Class IfcSolidModel

7.65.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: An IfcSolidModel is a complete representation of the nominal shape of a product such that all points in the interior are connected. Any point can be classified as being inside, outside, or on the boundary of a solid. There are several different types of solid model representations.

Definition from IAI: In addition to ISO 10303-42 two new subtypes are defined, IfcAttDrivenExtrudedSolid and IfcAttDrivenRevolvedSolid. Both define multi segment swept area solids, where the definition of the area to be swept is defined by attribute driven profile definitions.

NOTE Corresponding STEP entity: *solid_model*, only three subtypes have been incorporated into IFC Release 1.5 & 2.0 - part of *manifold_solid_brep* (IfcManifoldSolidBrep, constraint to faceted B-rep), *swept_area_solid* (IfcSweptAreaSolid), and part of *csg_soli*d (IfcCsgSolid). The derived attribute *Dim* has been added at this level and was therefore demoted from the *geometric_representation_item*. Please refer to ISO/IS 10303-42:1994, p. 170 for the final definition of the formal standard.

ISSUE: See I-330 for changes made in IFC Release 1.5.1

7.65.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcSolidModel
IfcCsgSolid
IfcManifoldSolidBrep
IfcSweptAreaSolid
IfcAttDrivenExtrudedSolid
IfcAttDrivenRevolvedSolid

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Dim	The space dimensionality of this class, it is always 3 within the scope of this IFC Release.	IfcDimensionCount	3	3	3

7.65.3. Interface Definitions

I_SolidModel

7.66. Class IfcSurface

7.66.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: An IfcSurface can be envisioned as a set of connected points in 3-dimensional space which is always locally 2-dimensional, but need not be a manifold.

NOTE Corresponding STEP entity: *surface*, only two subtypes have been incorporated into IFC Release 1.5 - elementary_surface (as IfcElementarySurface) and a limited adaptation of bounded_surface (as IfcCurveBoundedPlane). Please refer to ISO/IS 10303-42:1994, p. 68 for the final definition of the formal standard.

ISSUE: See issue I-226 for changes made in IFC Release 1.5.

7.66.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcSurface

IfcCurveBoundedPlane
IfcElementarySurface

Attributes and Relationships

No attributes defined at this level.

Informal Propositions

IP21	A surface has non zero area.
IP22	A surface is arcwise connected.

7.66.3. Interface Definitions

I_Surface

7.67. Class IfcSweptAreaSolid

7.67.1. Class Semantic Definition

Definition from IAI: The IfcSweptAreaSolid collects the entities which are defined procedurally by a sweeping action on bounded planar surface. The position in space of the swept area solid will be dependent upon the position of the Swept Area. In case of an IfcAttDrivenExtrudedSegment or IfcAttDrivenRevolvedSegment additional constraints apply to the position of the Swept Area, the extrusion direction and depth, or the revolution axis and angle. The Swept Area will be an area of the IfcSweptAreaSolid, except for the case of a IfcRevolvedAreaSolid with angle equal to 2π (or 360 degrees).

NOTE Corresponding STEP entity: *swept_area_solid*, The data type of *SweptArea* is modified and thereby further constraint to IfcCurveBoundedPlane. Please refer to ISO/IS 10303-42:1994, p. 183 for the final definition of the formal standard.

ISSUE: See issue I-019 for changes made in IFC Release 1.5.

7.67.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcSolidModel
IfcSweptAreaSolid
IfcExtrudedAreaSolid
IfcRevolvedAreaSolid

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	SweptArea	The surface defining the area to be swept.	IfcCurveBoundedPlane	n/a	n/a	n/a

Formal Propositions

WR31	The surface being swept shall be a plane surface.

7.67.3. Interface Definitions

I_SweptAreaSolid

7.68. Class IfcTopologicalRepresentationItem

7.68.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: The topological representation item is the supertype for all the topological representation items in the geometry resource.

NOTE Corresponding STEP entity: *topological_representation_item.* Please refer to ISO/IS 10303-42:1994, p.129 for the final definition of the formal standard.

ISSUE: See issue GI-003 for changes made in IFC Release 1.5.

7.68.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcTopologicalRepresentationItem
IfcConnectedFaceSet
IfcFace
IfcFaceBound
IfcVertex
IfcEdge
IfcPath

Attributes and Relationships

No attributes defined at this level.

7.68.3. Interface Definitions

I_TopologicalRepresentationItem

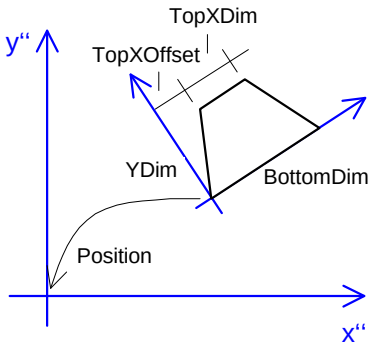
7.69. Class IfcTrapeziumProfileDef

7.69.1. Class Semantic Definition

Definition from IAI: The IfcTrapeziumProfileDef defines a trapezium as the profile definition used by the attribute driven geometric representation. It is given by its Top X and Bottom X extent and its Y extent as well as by the offset of the Top X extend, all measured against its implicit 2D coordinate system, after being placed by Position within the local coordinate system.

ISSUE: See issue I-035 for changes made in IFC Release 1.5.

ILLUSTRATION:



Position

The Position attribute of its supertype IfcAttDrivenProfileDef defines the 2D Placement of the Profile within the X''Y'' coordinate system, in which the derived bounded curve is defined.

Parameter

The IfcTrapeziumProfileDef is defined within the position coordinate system, where the BottomDim defines the length measure along the positive x-axis for the bottom line and the YDim defines the length measure along the positive y-axis for the parallel distance of bottom and top line. The top line starts with a distance of TopXOffset from [0,YDim] and has a length of TopXDim along the positive x-axis.

7.69.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcAttDrivenProfileDef
IfcTrapeziumProfileDef

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	BottomXDim	The extent of the bottom line measured along the implicit x-axis	IfcPositiveLengthMeasure	see type	see type	1
	TopXDim	The extent of the top line measured along the implicit x-axis	IfcPositiveLengthMeasure	see type	see type	1
	YDim	The extent of the distance between the parallel bottom and top lines measured along the implicit y-axis	IfcPositiveLengthMeasure	see type	see type	1
	TopXOffset	Offset from the beginning of the top line to the bottom line, measured along the implicit x-axis	IfcLengthMeasure	see type	see type	0
	CurveForSurface	Redefinition of the CurveForSurface defined in the supertype as being derived. A function is given that constructs an IfcPolyline out of the trapezium.	IfcPolyline	n/a	n/a	n/a

7.69.3. Interface Definitions

I_TrapeziumProfileDef

7.70. Class IfcTrimmedCurve

7.70.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: A Trimmed Curve is a bounded curve which is created by taking a selected portion, between two identified points, of the associated basis curve. The basis curve itself is unaltered and more than one trimmed curve may reference the same basis curve. Trimming points for the curve may be identified by

- parametric value

- geometric position
- both of the above

At least one of these shall be specified at each end of the curve. The *SenseAgreement* makes it possible to unambiguously define any segment of a closed curve such as a circle. The combinations of sense and ordered end points make it possible to define four distinct directed segments connecting two different points on a circle or other closed curve. For this purpose cyclic properties of the parameter range are assumed; for example, 370 degrees is equivalent to 10 degrees.

The IfcTrimmedCurve has a parameterization which is inherited from the particular basis curve reference. More precisely the parameter *s* of the trimmed curve is derived from the parameter of the basis curve as follows:

- if SenseAgreement is TRUE: $s = t - t_1$
- if SenseAgreement is FALSE: $s = t_2 - t$

In the above equations t_1 is the value given by *Trim1* or the parameter value corresponding to point 1 and t_2 is the value given by *Trim2* or the parameter value corresponding to point 2. The resultant IfcTrimmedCurve has a parameter ranging from 0 at the first trimming point to $|t_2 - t_1|$ at the second trimming point.

NOTE Corresponding STEP entity: *trimmed_curve*; As a further IFC restriction, an IfcTrimmedCurve should only trim a IfcLine or IfcConic. Please refer to ISO/IS 10303-42:1994, p. 54 for the final definition of the formal standard.

7.70.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
  IfcCurve
    IfcBoundedCurve
      IfcTrimmedCurve

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	BasisCurve	The curve to be trimmed	IfcCurve	n/a	n/a	n/a
	Trim1	The first trimming point which may be specified as a Cartesian point, as a real parameter or both	SET [1:2] OF IfcTrimmingSelect	1	2	1
	Trim2	The second trimming point which may be specified as a cartesian point, as a rela parameter or both	SET [1:2] OF IfcTrimmingSelect	1	2	1
	SenseAgreement	Flag to indicate whether the direction of the trimmed curve agrees with or is opposed to the direction of the basis curve.	BOOLEAN	see type	see type	TRUE
	MasterRepresentation	Where both parameter and point are present at either end of the curve this indicates the prefered form.	IfcTrimmingPreference	Cartesian	Parameter	Parameter

Formal Propositions

WR41	Either a single value is specified for Trim1, or the two trimming values are of different type (point and parameter)
WR42	Either a single value is specified for Trim2, or the two trimming values are of different type (point and parameter)
WR43	Only line and conic curves should be trimmed, not other bounded curves. NOTE: This is an additional constraint of IFC.

Informal Propositions

IP41	Where both the parameter value and the Cartesian point exist for Trim1 and Trim2 they shall be consistent. (i.e., the Basis Curve evaluated at the parameter value shall coincide with the specified point.
IP42	When a Cartesian point is specified by Trim1 or by Trim2 it shall lie on the Basis Curve.
IP43	Except the case of a closed Basis Curve where both parameter 1 and parameter 2 exist they shall be consistent with the sense flag, i.e., (sense = parameter 1
IP44	If both parameter 1 and parameter 2 exist, than parameter 1 <> parameter 2.
IP45	When a parameter value is specified by Trim1 or Trim2 it shall lie within the parametric range of the Basis Curve.

7.70.3. Interface Definitions

I_TrimmedCurve

7.71. Class IfcVector

7.71.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: The vector is defined in terms of the direction and magnitude of the vector. The value of the Magnitude attribute defines the magnitude of the vector.

Note, the magnitude of the vector can not be reliable calculated from the components of the Orientation attribute. This form of representation was selected to reduce problems with numerical instability. For example a vector of magnitude 2.0 mm and equally inclined to the coordinate axes could be represented with Orientation attribute of (1.0,1.0,1.0).

NOTE Corresponding STEP entity: *vector.* The derived attribute *Dim* has been added at this level and was therefore demoted from the *geometric_representation_item*. Please refer to ISO/IS 10303-42:1994, p. 27 for the final definition of the formal standard.

7.71.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcGeometricRepresentationItem
IfcVector

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Orientation	The direction of the vector	IfcDirection	n/a	n/a	n/a
	Magnitude	The magnitude of the vector	IfcLengthMeasure	see type	see type	1
	Dim	The space dimensionality of this class, it is derived from Orientation	IfcDimensionCount	2	3	3

Formal Propositions

WR21	The magnitude shall be positive or zero

7.71.3. Interface Definitions

I_Vector

7.72. Class IfcVertex

7.72.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: A vertex is the topological construct corresponding to a point. It has dimensionality 0 and extent 0. The domain of a vertex, if present (not in current IFC release), is a point in m dimensional real space R^M.

NOTE Corresponding STEP entity: *vertex.* Please refer to ISO/IS 10303-42:1994, p. 129 for the final definition of the formal standard.

History

New Entity in IFC Release 2.0

7.72.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcTopologicalRepresentationItem
IfcVertex

Attributes and Relationships

No attributes defined at this level.

Informal Propositions

IP21	The vertex has dimensionality 0. This is a fundamental property of the vertex.
IP22	The extent of a vertex is defined to be zero.

7.72.3. Interface Definitions

I_Vertex

7.73. Function IfcBooleanChoose

7.73.1. Function Semantic Definition

Definition from ISO/CD 10303-42:1992: This function returns one of two choices depending on the value of a Boolean input argument. The two choices are also input arguments.

NOTE Corresponding STEP function *boolean_choose*. Please refer to ISO/IS 10303-42:1994, p. 158 for the final definition of the formal standard.

History

New Function in IFC Release 2.0

7.74. Function IfcBuild2Axes

7.74.1. Function Semantic Definition

Definition from ISO/CD 10303-42:1992: This function returns two orthogonal directions. U[1] is in the direction of RefDirection and U[2] is perpendicular to U[1]. A default value of (1.0,0.0,0.0) is supplied for RefDirection if the input data is incomplete.

NOTE Corresponding STEP function *build_2axes*, new function in IFC Release 1.5. Please refer to ISO/IS 10303-42:1994, p. 100 for the final definition of the formal standard.

7.75. Function IfcBuildAxes

7.75.1. Function Semantic Definition

Definition from ISO/CD 10303-42:1992: This function builds and returns three normalized orthogonal directions. U[3] is the direction of axis. U[1] is in the direction of the projection of RefDirection onto the plane normal to U[3] and U[2] is the cross product of U[3] and U[1]. Default values are supplied if input data is incomplete.

NOTE Corresponding STEP function *build_axes*, new function in IFC Release 1.5. Please refer to ISO/IS 10303-42:1994, p. 100 for the final definition of the formal standard.

7.76. Function IfcCircleProfileIntoCurve

7.76.1. Function Semantic Definition

Definition from IAI: This function returns a bounded curve of type IfcTrimmedCurve from the input parameters of the attribute driven circular profile definition.

7.77. Function IfcCrossProduct

7.77.1. Function Semantic Definition

Definition from ISO/CD 10303-42:1992: This function returns the vector (or cross) product of two input directions. The input directions must be three-dimensional. The result is always a vector which is unitless. If the input directions are either parallel or anti-parallel a vector of zero magnitude is returned.

NOTE Corresponding STEP function *cross_product*, new function in IFC Release 1.5. Please refer to ISO/IS 10303-42:1994, p. 103 for the final definition of the formal standard.

7.78. Function IfcCurveDim

7.78.1. Function Semantic Definition

7.79. Function IfcDotProduct

7.79.1. Function Semantic Definition

Definition from ISO/CD 10303-42:1992: This function returns the scalar (or dot) product of two directions. The input arguments can be directions in either two- or three-dimensional space. The returned scalar is undefined if the input directions have different dimensionality, or if either is undefined.

NOTE Corresponding STEP function *dot_product*, new function in IFC Release 1.5. Please refer to ISO/IS 10303-42:1994, p. 104 for the final definition of the formal standard.

7.80. Function IfcExtrusionPath

7.80.1. Function Semantic Definition

Definition from IAI: This function returns a path definition, given as IfcPolyline. It takes an IfcAttDrivenExtrudedSolid as an input.

It is assumed that by virtue of the formal and informal propositions at IfcAttDrivenExtrudedSolid all of its Segments placement coordinate systems have their Z-Axis defines along a line.

7.81. Function IfcFirstProjAxis

7.81.1. Function Semantic Definition

Definition from ISO/CD 10303-42:1992: This function produces a three dimensional direction which is, with fully defined input, the projection of Arg onto the plane normal to the ZAxis. With Arg defaulted the result is the projection of (1.0,0.0,0.0) onto this plane except that if ZAxis = (1.0,0.0,0.0) then (0.0,1.0,0.0) is used as initial value of Arg. A violation occurs if Arg is in the same direction as the input ZAxis.

NOTE Corresponding STEP function *first_proj_axis*, new function in IFC Release 1.5. Please refer to ISO/IS 10303-42:1994, p. 102 for the final definition of the formal standard.

7.82. Function IfcNormalise

Function Semantic Definition

Definition from ISO/CD 10303-42:1992: This function returns a vector or direction whose components are normalized to have a sum of squares of 1.0. The output is of the same type (Direction or Vector, with the same units) as the input argument. If the input argument is not defined or of zero length then the output vector is undefined.

NOTE Corresponding STEP function *normalise*, new function in IFC Release 1.5. Please refer to ISO/IS 10303-42:1994, p. 105 for the final definition of the formal standard.

7.83. Function IfcOrthogonalComplement

7.83.1. Function Semantic Definition

Definition from ISO/CD 10303-42:1992: This function returns a direction which is the orthogonal complement of the input direction. The input direction must be a two-dimensional direction and the result is a vector of the same type and perpendicular to the input vector.

NOTE Corresponding STEP function *orthogonal_component,* new function in IFC Release 1.5. Please refer to ISO/IS 10303-42:1994, p. 101 for the final definition of the formal standard.

7.84. Function IfcPathHeadToTail

7.84.1. Function Semantic Definition

History

New Function in IFC Release 2.0

7.85. Function IfcPointTranslation

7.85.1. Function Semantic Definition

Definition from IAI: This function returns a Cartesian Point that has been transformed by a vector based on the previous position of the Cartesian Point. The input vector shall use normalized axes for its orientation definition.

7.86. Function IfcProfileIntoArea

7.86.1. Function Semantic Definition

Definition from IAI: This function returns a bounded plane surface for extrusion or revolution into a solid from the bounded closed input curve.

7.87. Function IfcRectangleProfileIntoCurve

7.87.1. Function Semantic Definition

Definition from IAI: This function returns a bounded curve of type IfcPolyline from the input parameters of the attribute driven rectangular definition.

7.88. Function IfcRevolutionPath

7.88.1. Function Semantic Definition

Definition from IAI: This function computes and returns the trajectory of the IfcAttDrivenProfileDef origin as an IfcTrimmedCurve. It takes an IfcAttDrivenRevolvedSolid as an input.

It is assumed that by virtue of the formal and informal propositions at IfcAttDrivenRevolvedSolid all of its Segments refers to the same placement coordinate system and to the same Axis.

7.89. Function IfcScalarTimesVector

Function Semantic Definition

Definition from ISO/CD 10303-42:1992: This function returns the vector that is the scalar multiple of the input vector. It accepts as input a scalar and a 'vector' which may be either a Direction or a Vector. The output is a Vector of the same units as the input vector or unitless if a direction is input. If either input argument is undefined then the returned vector is also undefined.

NOTE Corresponding STEP function *scalar_times_vector*, new function in IFC Release 1.5. Please refer to ISO/IS 10303-42:1994, p. 107 for the final definition of the formal standard.

7.90. Function IfcTrapeziumProfileIntoCurve

7.90.1. Function Semantic Definition

Definition from IAI: This function returns a bounded curve of type IfcPolyline from the input parameters of the attribute driven trapezium profile definition.

7.91. Function IfcVectorDifference

7.91.1. Function Semantic Definition

Definition from ISO/CD 10303-42:1992: This function returns the difference of the input arguments as (Arg1 - Arg2). The function returns as a vector the vector difference of the two input vectors. The input arguments shall both be of the same dimensionality but may be either directions or vectors. If both input arguments are vectors they must be expressed in the same units, if both are directions a unitless result is produced. A zero difference vector produces a vector of zero magnitude.

NOTE Corresponding STEP function *vector_difference*, new function in IFC Release 1.5. Please refer to ISO/IS 10303-42:1994, p. 109 for the final definition of the formal standard.

8. IfcMaterialResource

This schema contains the types and classes which are used to define and manipulate materials and their properties. Materials are defined generically, with references to the usage of materials being made from the relevant classes.

NOTE: The definitions in this schema were included in the IfcPropertyResource schema in Release 1.5.1.

8.1. Select IfcMaterialPropertySelect

8.1.1. Select Semantic Definition

Definition from IAI: Allows the selection of the various types of material property representations. IfcSimpleProperty and IfcSimplePropertyWithUnit were provided in previous versions. In Release 2.0 IfcTable was added to this schema to allow the storage of information where there are multiple values that need to be stored against a single attribute. For example, the acoustic absorption coefficients for materials

have multiple values depending on the frequency of the incident sound waves. The absorption coefficients for brick could be represented as follows:

Frequency (Hz)	Coefficient
125	0.05
500	0.02
2000	0.05

History

New Select Type in IFC Release 2.0

8.1.2. Select

IfcSimpleProperty
IfcSimplePropertyWithUnit
IfcTable

8.2. Select IfcMaterialSelect

8.2.1. Select Semantic Definition

Definition from IAI: Selection of whether a material, a material layer, a material layer set or a material list is used.

History

This Select Type has changed after IFC Release 1.5.1, please see the Migration Guide for details

8.2.2. Select

IfcMaterial
IfcMaterialList
IfcMaterialLayer
IfcMaterialLayerSet

8.3. Class IfcMaterial

8.3.1. Class Semantic Definition

Definition from IAI: A homogenous substance that can be used to form elements.

ISSUE: See Issue I342 for IFC Release 1.5.1

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

8.3.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	MaterialName	Name of the material.	STRING	see type	see type	n/a
OPT	MaterialClassification	The material classifications identifying the type of material.	IfcClassificationList	see type	see type	NIL
	MaterialFinishes	Finishes that are appropriate for this material. These finishes can be obtained by direct treatment of the surface of the material. This does NOT store information on applied finishes, such as paints, etc	SET [0:?] OF IfcMaterialFinish			
	Properties	The list of material properties defined for this material.	SET [0:?] OF IfcMaterialPropertySelect	N/A	N/A	N/A

8.3.3. Interface Definitions

- I_Material

8.4. Class IfcMaterialFinish

8.4.1. Class Semantic Definition

Definition from IAI: The properties of a type of finish that can be applied to the material itself (as distinct from an applied finish such as paint).

NOTE: New in IFC Release 2.0

History

New Entity in IFC Release 2.0

8.4.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	FinishName	Name of the finish treatment	STRING	see type	see type	n/a
	Properties	List of the surface properties that result from the use of this finish on the material.	LIST [0:?] OF IfcMaterialPropertySelect			
INV	ForMaterial	Reference to the material to which this finish is applied. Note: each Material/Finish combination will have unique attributes	IfcMaterial	n/a	n/a	required

8.4.3. Interface Definitions

- I_MaterialFinish

8.5. Class IfcMaterialLayer

8.5.1. Class Semantic Definition

Definition from IAI: A single and identifiable part constructed from a single material of an element which is constructed from a number of layers. For example, a cavity wall with brick masonry used in each leaf would be modeled using three IfcMaterialLayers.

ISSUE: Issue I327 for IFC Release 1.5.1

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

8.5.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Material	Material from which the material layer is constructed.	IfcMaterial	see type	see type	n/a
	OffsetFromMLSBase	The dimensional offset from the datum point of the material layer.	IfcLengthMeasure	see type	see type	n/a
	LayerThickness	The thickness of this layer.	IfcPositiveLengthMeasure	see type	see type	n/a
INV	ToMaterialLayerSet	Reference to the material layer set, in which the material layer is included.	IfcMaterialLayerSet	n/a	n/a	n/a

8.5.3. Interface Definitions

- I_MaterialLayer

8.6. Class IfcMaterialLayerSet

8.6.1. Class Semantic Definition

Definition from IAI: A designation by which an element which is constructed from a number of material layers is known and through which the relative positioning of individual layers can be expressed. An cavity brick wall would be modeled as IfcMaterialLayerSet consisting of three IfcMaterialLayers – brick, air cavity and brick.

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

8.6.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	HasMaterialLayers	Identification of the layers from which the material layer set is composed.	LIST [1:?] OF IfcMaterialLayer	see type	see type	n/a
	IsVentilated	Set to TRUE if there is air exchange from the cavity to the outside air.	BOOLEAN			

8.6.3. Interface Definitions

- I_MaterialLayerSet

8.7. Class IfcMaterialLayerSetUsage

8.7.1. Class Semantic Definition

Definition from IAI: Determines the usage of the material layer set in terms of its offset positioning relative to some baseline and the sense in which the material layers are measured. A cavity brick wall defined as an IfcMaterialLayerSet could be offset from a grid line by 100 mm.

ISSUE: See Issue I-327 for IFC Release 1.5.1

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

8.7.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	ForLayerSet	Layer set to which the usage is applied.	IfcMaterialLayerSet	see type	see type	n/a
	MlsOffsetFromBaseline	Offset from some baseline of the layer set. NOTE: By default, the sense of measurement is left to right and this takes the value TRUE.	IfcLengthMeasure	see type	see type	n/a
	MlsSenseLtoR	The sense in which the layer set is measured.	BOOLEAN	see type	see type	TRUE
	TotalThickness	Total thickness of the material layer set is derived from the function IfcMlsTotalThickness	IfcLengthMeasure	see type	see type	n/a

8.7.3. Interface Definitions

- I_MaterialLayerSetUsage

8.8. Class IfcMaterialList

8.8.1. Class Semantic Definition

Definition from IAI: A list of materials that are used in a non-homogenous element.
This will normally be used where an element is described at a more abstract level. For example, for in an architectural specification writer, the only information that may be needed about a concrete column is that it contains concrete, reinforcing steel and mild steel ligatures.

8.8.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Materials	Materials used in a composition of substances.	LIST [1:?] OF IfcMaterial	see type	see type	n/a

8.8.3. Interface Definitions

- I_MaterialComposite

8.9. Function IfcMlsTotalThickness

8.9.1. Function Semantic Definition

Definition from IAI: Calculates the total thickness of a material layer set from the thicknesses of the material layers and their offset from the layer set base.

9. IfcMeasureResource

The IfcMeasureResource schema is adapted from the ISO 10303 part 41 Measure schema and specifies units and measures that may be assigned to quantities.

Additional measures have been added to this schema to meet particular domain requirements.

The fundamental unit type used in this schema is based on the SI system defined in ISO 1000. Units in measurement systems other than SI may be derived using this schema.

A number of units of measure are identified using their derived units which are specified in terms of fundamental units as follows:

- Joule [J] kg.deg K/sec [W/sec]
- Newton [N] kg.m/sec^2
- Pascal [Pa} kg/m.sec^2 [N/m^2]
- Watt [W] kg.deg K

9.1. Type IfcAmountOfSubstanceMeasure

9.1.1. Type Semantic Definition

An amount of substance measure is the value for the quantity of a substance when compared with the number of atoms in 0.012kilogram of carbon 12.

9.1.2. Type

REAL

9.2. Type IfcAngularVelocityMeasure

9.2.1. Type Semantic Definition

A measure of the velocity of a body measured in terms of angle subtended per unit time.

Usually measured in radians/s.

History

New Defined Type in IFC Release 2.0

9.2.2. Type

REAL

9.3. Type IfcAreaMeasure

9.3.1. Type Semantic Definition

An area measure is the value of the extent of a surface.

9.3.2. Type

REAL

9.4. Type IfcBoolean

9.4.1. Type Semantic Definition

A defined data type of simple data type Boolean. . (Required since a select type, i.e. IfcMeasureValue, cannot include directly simple types in its select list).

9.4.2. Type

BOOLEAN

9.5. Type IfcCompoundPlaneAngleMeasure

9.5.1. Type Semantic Definition

A compound measure of plane angle in degrees minutes and seconds of arc.

NOTE: IfcCompoundPlaneAngleMeasure is used where angles need to be described to an accuracy of less than one degree and expressed as parts of an arc. It may be used for angular measurement by surveyors or for other angular measurements where precision is required. It should not be used for angular measurements which may be expressed in decimal fractions of a degree; for which purpose the IfcPlaneAngleMeasure is provided.

9.5.2. Type

LIST [3:3] OF INTEGER

Formal Propositions

WR1	{ 0 <= SELF[1]
WR2	{ 0 <= SELF[2]
WR3	{ 0 <= SELF[3]

9.6. Type IfcContextDependentMeasure

9.6.1. Type Semantic Definition

A context dependent measure is a general purpose real number measure type.

9.6.2. Type

REAL

9.7. Type IfcCountMeasure

9.7.1. Type Semantic Definition

A count measure is the value of a count.

9.7.2. Type

NUMBER

9.8. Type IfcDescriptiveMeasure

9.8.1. Type Semantic Definition

A descriptive measure is a human interpretable definition of a quantifiable value.

9.8.2. Type

STRING

9.9. Type IfcDynamicViscosityMeasure

9.9.1. Type Semantic Definition

A measure of the viscous resistance of a medium.

Usually measured in Pascals second

History

New Defined Type in IFC Release 2.0

9.9.2. Type

REAL

9.10. Type IfcElectricCurrentMeasure

9.10.1. Type Semantic Definition

A standard unit of measure for electrical current, equal to one Coulomb per second.

9.10.2. Type

REAL

9.11. Type IfcElectricVoltageMeasure

9.11.1. Type Semantic Definition

A measure of electromotive force.

Usually measured in Volts.

History

New Defined Type in IFC Release 2.0

9.11.2. Type

REAL

9.12. Type IfcEnergyMeasure

9.12.1. Type Semantic Definition

A measure of energy required or used.

Usually measured in Joules.

History

New Defined Type in IFC Release 2.0

9.12.2. Type

REAL

9.13. Type IfcFrequencyMeasure

9.13.1. Type Semantic Definition

A measure of the number of times that an item revolves, vibrates etc. in unit time.

Usually measured in revolutions/second or Herz.

History

New Defined Type in IFC Release 2.0

9.13.2. Type

REAL

9.14. Type IfcHeatFluxDensityMeasure

9.14.1. Type Semantic Definition

A measure of the density of heat flux within a body.

Usually measured in Watts/meters2.

History

New Defined Type in IFC Release 2.0

9.14.2. Type

REAL

9.15. Type IfcInteger

9.15.1. Type Semantic Definition

A defined type of simple data type Integer. (Required since a select type, i.e. IfcMeasureValue, cannot include directly simple types in its select list).

In principle, the domain of IfcInteger (being an Integer) is all integer numbers. Here the number of bits used for the IfcInteger representation is unconstrained, but in practise it's implementation specific.

9.15.2. Type

INTEGER

9.16. Type IfcIntegerCountRateMeasure

9.16.1. Type Semantic Definition

A measure of the integer number of units flowing per unit time.

This measure may be used for measuring integer units per second or per hour. For example, it may be used to measure the number of books per hour passing along a part of a mechanical book handling system, the number of people per hour travelling along a moving walkway or the number of vehicles per hour travelling along a section of road.

History

New Defined Type in IFC Release 2.0

9.16.2. Type

INTEGER

9.17. Type IfcKinematicViscosityMeasure

9.17.1. Type Semantic Definition

A measure of the viscous resistance of a medium to a moving body.

Usually measured in square meters/second.

History

New Defined Type in IFC Release 2.0

9.17.2. Type

REAL

9.18. Type IfcLengthMeasure

9.18.1. Type Semantic Definition

A length measure is the value of a distance.

9.18.2. Type

REAL

9.19. Type IfcLinearVelocityMeasure

9.19.1. Type Semantic Definition

A measure of the velocity of a body measured in terms of distance moved per unit time.

Usually measured in meters/second

History

New Defined Type in IFC Release 2.0

9.19.2. Type

REAL

9.20. Type IfcLuminousIntensityMeasure

9.20.1. Type Semantic Definition

A luminous intensity measure is the value for the brightness of a body.

9.20.2. Type

REAL

9.21. Type IfcMassDensityMeasure

9.21.1. Type Semantic Definition

A measure of the density of a medium.

Usually measured in kilograms/cubic meters.

History

New Defined Type in IFC Release 2.0

9.21.2. Type

REAL

9.22. Type IfcMassFlowRateMeasure

9.22.1. Type Semantic Definition

A measure of the mass of a medium flowing per unit time.

Usually measured in kilograms/second

History

New Defined Type in IFC Release 2.0

9.22.2. Type

REAL

9.23. Type IfcMassMeasure

9.23.1. Type Semantic Definition

A mass measure is the value of the amount of matter that a body contains.

9.23.2. Type

REAL

9.24. Type IfcMonetaryMeasure

9.24.1. Type Semantic Definition

A monetary measure is the value of an amount of money without regard to its currency.

History

New Defined Type in IFC Release 2.0

9.24.2. Type

REAL

9.25. Type IfcNumericMeasure

9.25.1. Type Semantic Definition

A numeric measure is the numeric value of a physical quantity.

9.25.2. Type

NUMBER

9.26. Type IfcParameterValue

9.26.1. Type Semantic Definition

A parameter value is the value which specifies the amount of a parameter in some parameter space.

9.26.2. Type

REAL

9.27. Type IfcPlaneAngleMeasure

9.27.1. Type Semantic Definition

A plane angle measure is the value of an angle in a plane.

IfcPlaneAngleMeasure is used where angles need to be described to an accuracy of less than one degree and expressed as decimal parts of an angle. It is widely used for angular measurement except for situations where accuracy needs to be defined using arc measurement; for which purpose the IfcCompoundPlaneAngleMeasure is provided.

9.27.2. Type

REAL

9.28. Type IfcPositiveLengthMeasure

9.28.1. Type Semantic Definition

A positive length measure is a length measure that is greater than zero.

9.28.2. Type

IfcLengthMeasure

Formal Propositions

WR1	SELF 0

9.29. Type IfcPositivePlaneAngleMeasure

9.29.1. Type Semantic Definition

A positive plane angle measure is a plane angle measure that is greater than zero.

9.29.2. Type

IfcPlaneAngleMeasure

Formal Propositions

WR1	SELF 0

9.30. Type IfcPositiveRatioMeasure

9.30.1. Type Semantic Definition

A positive ratio measure is a ratio measure that is greater than zero.

9.30.2. Type

IfcRatioMeasure

Formal Propositions

WR1	SELF 0

9.31. Type IfcPowerMeasure

9.31.1. Type Semantic Definition

A measure of power required or used.

Usually measured in Watts.

History

New Defined Type in IFC Release 2.0

9.31.2. Type

REAL

9.32. Type IfcPressureMeasure

9.32.1. Type Semantic Definition

A measure of the quantity of a medium acting on a unit area.

Usually measured in Pascals.

History

New Defined Type in IFC Release 2.0

9.32.2. Type

REAL

9.33. Type IfcRatioMeasure

9.33.1. Type Semantic Definition

A ratio measure is the value of the relation between two physical quantities that are of the same kind.

9.33.2. Type

REAL

9.34. Type IfcReal

9.34.1. Type Semantic Definition

A defined type of simple data type Real (required since a select type, i.e. IfcMeasureValue, cannot include directly simple types in its select list).

In principle, the domain of IfcReal (being a Real) is all rational, irrational and scientific real numbers. Here the precision is unconstrained, but in practise it's implementation specific.

9.34.2. Type

REAL

9.35. Type IfcSolidAngleMeasure

9.35.1. Type Semantic Definition

A solid angle measure is the value of an angle in a solid.

9.35.2. Type

REAL

9.36. Type IfcString

9.36.1. Type Semantic Definition

A defined type of simple data type String. (Required since a select type, i.e. IfcMeasureValue, cannot include directly simple types in its select list).

9.36.2. Type

STRING

9.37. Type IfcThermalAdmittanceMeasure

9.37.1. Type Semantic Definition

The measure of the ability of a surface to smooth out temperature variations.

Usually measured in Watt / square meters degrees Kelvin.

History

New Defined Type in IFC Release 2.0

9.37.2. Type

REAL

9.38. Type IfcThermalResistanceMeasure

9.38.1. Type Semantic Definition

A measure of the resistance offered by a body to the flow of energy.

Usually measured in square meters degrees Kelvin / Watt.

History

New Defined Type in IFC Release 2.0

9.38.2. Type

REAL

9.39. Type IfcThermalTransmittanceMeasure

9.39.1. Type Semantic Definition

A measure of the rate at which energy is transmitted through a body.

Usually measured in Watts/ square meters degrees Kelvin.

History

New Defined Type in IFC Release 2.0

9.39.2. Type

REAL

9.40. Type IfcThermodynamicTemperatureMeasure

9.40.1. Type Semantic Definition

A thermodynamic temperature measure is the value for the degree of heat of a body.

9.40.2. Type

REAL

9.41. Type IfcTimeMeasure

9.41.1. Type Semantic Definition

A time measure is the value of the duration of periods.

9.41.2. Type

REAL

9.42. Type IfcTimeStamp

9.42.1. Type Semantic Definition

An indication of date and time by measuring the number of seconds which have elapsed since the beginning of the year 1970.

9.42.2. Type

INTEGER

9.43. Type IfcVolumeMeasure

9.43.1. Type Semantic Definition

A volume measure is the value of the solid content of a body.

9.43.2. Type

REAL

9.44. Type IfcVolumetricFlowrateMeasure

9.44.1. Type Semantic Definition

A measure of the volume of a medium flowing per unit time.

Usually measured in cubic meters/second.

History

New Defined Type in IFC Release 2.0

9.44.2. Type

REAL

9.45. Select IfcMeasureValue

9.45.1. Select Semantic Definition

A measure value is a value as defined in ISO 31-0 (clause 2).

IfcMeasureValue is a select data type which includes in its select list all various type of defined data type measures.

History

This Select Type has changed after IFC Release 1.5.1, please see the Migration Guide for details

9.45.2. Select

IfcAmountOfSubstanceMeasure
IfcAngularVelocityMeasure
IfcAreaMeasure
IfcBoolean
IfcCompoundPlaneAngleMeasure
IfcContextDependentMeasure
IfcCountMeasure
IfcDescriptiveMeasure
IfcDynamicViscosityMeasure
IfcElectricCurrentMeasure
IfcElectricVoltageMeasure
IfcEnergyMeasure
IfcHeatFluxDensityMeasure
IfcInteger
IfcIntegerCountRateMeasure
IfcKinematicViscosityMeasure
IfcLengthMeasure
IfcLinearVelocityMeasure
IfcLuminousIntensityMeasure
IfcMassDensityMeasure
IfcMassFlowRateMeasure

IfcMassMeasure
IfcMonetaryMeasure
IfcNumericMeasure
IfcParameterValue
IfcPlaneAngleMeasure
IfcPositiveLengthMeasure
IfcPositivePlaneAngleMeasure
IfcPositiveRatioMeasure
IfcPowerMeasure
IfcPressureMeasure
IfcRatioMeasure
IfcReal
IfcFrequencyMeasure
IfcSolidAngleMeasure
IfcString
IfcThermalAdmittanceMeasure
IfcThermalResistanceMeasure
IfcThermalTransmittanceMeasure
IfcThermodynamicTemperatureMeasure
IfcTimeMeasure
IfcTimeStamp
IfcVolumeMeasure
IfcVolumetricFlowrateMeasure

9.46. Select IfcUnit

9.46.1. Select Semantic Definition

A unit is a physical quantity, with a value of one, which is used as a standard in terms of which other quantities are expressed.

9.46.2. Select

IfcDerivedUnit
IfcNamedUnit

9.47. Type IfcCurrencyEnum

9.47.1. Type Semantic Definition

An enumeration type of currencies of various countries.

9.47.2. Enumeration

AED	United Arab Emirates
AES	Argentina
ATS	Austria

AUD	Australia
BBD	Barbados
BEG	Belgium
BGL	Bulgaria
BHD	Bahrain
BMD	Bermuda
BND	Brunei
BRL	Brazil
BSD	Bahamas
BWP	Botswana
BZD	Belize
CAD	Canada
CBD	Carribean
CHF	Switzerland
CLP	Chile
CNY	China
CYS	Cyprus
CZK	Czech Republic
DDP	Dominican Republic
DEM	Germany
DKK	Denmark
EGL	Egypt
EST	Spain
EUR	A currency adopted by a number of countries within the European Union from January 1st 1999. The zone in which the currency operates is termed 'Euroland' in financial transactions
FAK	Faroe Islands
FIM	Finland
FJD	Fiji
FKP	Falkland Islands
FRF	France
GBP	United Kingdom
GIP	Gibraltar
GMD	Gambia
GRX	Greece
HKD	Hong Kong
HUF	Hungary
ICK	Iceland
IDR	Indonesia
ILS	Israel
INR	India
IRP	Ireland
ITL	Italy
JMD	Jamaica
JOD	Jordan
JPY	Japan
KES	Kenya
KRW	Republic of Korea
KWD	Kuwait
KYD	Cayman Islands

LKR	Sri Lanka
LUF	Luxembourg
MTL	Malta
MUR	Mauritius
MXN	Mexico
MYR	Malaysia
NLG	Netherlands
NZD	New Zealand
OMR	Oman
PGK	Papua New Guinea
PHP	Philipines
PKR	Pakistan
PLN	Poland
PTN	Portugal
QAR	Qatar
RUR	Russia
SAR	Saudi Arabia
SCR	Seychelles
SEK	Sweden
SGD	Singapore
SKP	St.Helena
THB	Thailand
TRL	Turkey
TTD	Trinidad and Tobago
TWD	Taiwan
USD	United States of America
VEB	Venezuela
VND	Viet-Nam
XEU	Europe (States of the European Union)
ZAR	South Africa
ZWD	Zimbabwe

9.48. Type IfcDerivedUnitEnum

9.48.1. Type Semantic Definition

An enumeration type for allowed types of derived units.

9.48.2. Enumeration

AngularVelocityUnit
DynamicViscosityUnit
ElectricVoltageUnit
EnergyUnit
HeatfluxDensityUnit
IntegerCountRateUnit
KinematicViscosityUnit
LinearVelocityUnit

MassDensityUnit
MassFlowrateUnit
PowerUnit
PressureUnit
RotationalFrequencyUnit
ThermalAdmittanceUnit
ThermalResistanceUnit
ThermalTransmittanceUnit
VolumetricFlowrateUnit
UserDefined
NotDefined

9.49. Type IfcSiPrefix

9.49.1. Type Semantic Definition

An SI prefix is the name of a prefix that may be associated with an si unit. The definitions of SI prefixes are specified in ISO 1000 (clause 3).

9.49.2. Enumeration

EXA
PETA
TERA
GIGA
MEGA
KILO
HECTO
DECA
DECI
CENTI
MILLI
MICRO
NANO
PICO
FEMTO
ATTO

9.50. Type IfcSiUnitName

9.50.1. Type Semantic Definition

An SI unit name is the name of an SI unit. The definitions of the names of SI units are specified in ISO 1000 (clause 2).

9.50.2. Enumeration

METRE

SQUARE_METRE
CUBIC_METRE
GRAM
SECOND
AMPERE
KELVIN
MOLE
CANDELA
RADIAN
STERADIAN
HERTZ
NEWTON
PASCAL
JOULE
WATT
COULOMB
VOLT
FARAD
OHM
SIEMENS
WEBER
TESLA
HENRY
DEGREE_CELSIUS
LUMEN
LUX
BECQUEREL
GRAY
SIEVERT

9.51. Type IfcUnitEnum

9.51.1. Type Semantic Definition

An enumeration type for allowed unit types of IfcNamedUnit.

9.51.2. Enumeration

LengthUnit
MassUnit
TimeUnit
DurationUnit
ElectricCurrentUnit
ThermodynamicTemperatureUnit
AmountOfSubstanceUnit
LuminousIntensityUnit
PlaneAngleUnit
SolidAngleUnit

AreaUnit
VolumeUnit
RatioUnit
Unspecified

9.52. Class IfcContextDependentUnit

9.52.1. Class Semantic Definition

An context dependent unit is a unit which is not related to the SI system.

NOTE: The number of parts in an assembly is a physical quantity measured in units that may be called “parts" but which cannot be related to an SI unit.

9.52.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcNamedUnit
IfcContextDependentUnit

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Name	The word, or group of words, by which the context dependent unit is referred to.	STRING	see type	see type	empty string

9.52.3. Interface Definitions

- I_ContextDependentUnit

9.53. Class IfcConversionBasedUnit

9.53.1. Class Semantic Definition

A conversion based unit is a unit that is defined based on a measure with unit.

NOTE: An inch is a converted unit. It is from the Imperial system, its name is “inch" and it can be related to the si unit, millimetre, through a measure with unit whose value is 25.4 millimetre. A foot is also a converted unit. It is from the Imperial system, its name is “foot" and it can be related to an si unit, millimetre, either directly or through the unit called “inch".

9.53.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcNamedUnit
IfcConversionBasedUnit

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default

	Name	The word, or group of words, by which the conversion based unit is referred to.	STRING	see type	see type	empty string
	ConversionFactor	The physical quantity from which the converted unit is derived.	IfcMeasureWithUnit	see type	see type	see type

9.53.3. Interface Definitions

- I_ConversionBasedUnit

9.54. Class IfcDerivedUnit

9.54.1. Class Semantic Definition

A derived unit is an expression of units.

NOTE: Newton per square millimetre is a derived unit.

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

9.54.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Elements	The group of units and their exponents that define the derived unit.	SET [1:?] OF IfcDerivedUnitElement	1	N	see WR1
	UnitType	Name of the derived unit – selected from a predefined enumeration for use in IFC models.	IfcDerivedUnitEnum	VolumetricFlowrateUnit	Unspecified	Unspecified
	Dimensions	Dimensional exponents are derived using the function IfcDerivedDimensionalExponents using (SELF) as the input value.	IfcDimensionalExponents	see type	see type	n/a

Formal Propositions

WR1	There shall be either more than one member in the elements set or the value of the exponent of the single element of the elements set shall not be equal to one.

9.54.3. Interface Definitions

- I_DerivedUnit

9.55. Class IfcDerivedUnitElement

9.55.1. Class Semantic Definition

A derived unit element is one of the unit quantities which makes up a derived unit.

EXAMPLE: Newtons per square millimetre is a derived unit. It has two elements, Newton whose exponent has a value of 1 and millimetre whose exponent is -2.

9.55.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Unit	The fixed quantity which is used as the mathematical factor.	IfcNamedUnit	see type	see type	see type
	Exponent	The power that is applied to the unit attribute.	INTEGER	see type	see type	1

9.55.3. Interface Definitions

- I_DerivedUnitElement

9.56. Class IfcDimensionalExponents

9.56.1. Class Semantic Definition

The dimensionality of any quantity can be expressed as a product of powers of the dimensions of base quantities. The dimensional exponents entity defines the powers of the dimensions of the base quantities. All the physical quantities are founded on seven base quantities (ISO 31 (clause 2)).

NOTE: Length, mass, time, electric current, thermodynamic temperature, amount of substance, and luminous intensity are the seven base quantities.

EXAMPLE: A length of 2 millimetres has a length exponent of 1. The remaining exponents are equal to 0.

EXAMPLE: A velocity of 2 millimetres per second has a length exponent of 1 and a time exponent of -1. The remaining exponents are equal to 0.

9.56.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	LengthExponent	The power of the length base quantity.	INTEGER	see type	see type	1
	MassExponent	The power of the mass base	INTEGER	see type	see type	0

		quantity.				
	TimeExponent	The power of the time base quantity.	INTEGER	see type	see type	0
	ElectricCurrentExponent	The power of the electric current base quantity.	INTEGER	see type	see type	0
	ThermodynamicTemperatureExponent	The power of the thermodynamic temperature base quantity.	INTEGER	see type	see type	0
	AmountOfSubstanceExponent	The power of the amount of substance base quantity.	INTEGER	see type	see type	0
	LuminousIntensityExponent	The power of the luminous intensity base quantity.	INTEGER	see type	see type	0

9.56.3. Interface Definitions

- I_DimensionalExponents

9.57. Class IfcMeasureWithUnit

9.57.1. Class Semantic Definition

A measure with unit is the specification of a physical quantity as defined in ISO 31 (clause 2).

9.57.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	ValueComponent	the value of the physical quantity when expressed in the specified units.	IfcMeasureValue	see type	see type	IfcLength Measure
	UnitComponent	the unit in which the physical quantity is expressed.	IfcUnit	see type	see type	IfcNamed Unit

9.57.3. Interface Definitions

- I_MeasureWithUnit

9.58. Class IfcNamedUnit

9.58.1. Class Semantic Definition

A named unit is a unit quantity associated with the word, or group of words, by which the unit is identified.

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

9.58.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcNamedUnit
IfcConversionBasedUnit
IfcContextDependentUnit
IfcSiUnit

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Dimensions	The exponents of the base properties by which the named unit is defined.	IfcDimensionalExponents	see type	see type	1,0,0,0,0,0,0
	UnitType	Type of unit used.	IfcUnitEnum	see type	see type	LengthUnit

Formal Propositions

WR1	Correct dimensions are established through the function IfcCorrectDimensions. IfcCorrectDimensions (SELF.UnitType, Self.Dimensions)

9.58.3. Interface Definitions

- I_NamedUnit

9.59. Class IfcSiUnit

9.59.1. Class Semantic Definition

An SI unit is the fixed quantity used as a standard in terms of which items are measured as defined by ISO 1000 (clause 2).

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

9.59.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcNamedUnit
IfcSiUnit

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
OPT	Prefix	The SI Prefix	IfcSiPrefix	EXA	ATTO	MILLI
	Name	The word, or group of words, by which the SI unit is referred to.	IfcSiUnitName	METRE	SIEVERT	METRE
	SELF\IfcNamedUnit.Dimensions		IfcDimensionalExponents			

9.59.3. Interface Definitions

- I_SiUnit

9.60. Class IfcUnitAssignment

9.60.1. Class Semantic Definition

A set of units which may be assigned.

NOTE: A project has a unit assignment which establishes the set of units which will be used. Other objects may have local unit assignments if there is a requirement for them to make use of units which do not fall within the project unit assignment.

9.60.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Units	Units to be included within a unit assignment.	SET [1:?] OF IfcUnit	1	N	1

9.60.3. Interface Definitions

- I_UnitAssignment

9.61. Function IfcCorrectDimensions

9.61.1. Function Semantic Definition

The correct dimensions function returns the dimensional exponents of the given unit type.

Argument definitions:

X: (input) the name of the unit type for which the dimensional exponents are tested.

9.62. Function IfcDeriveDimensionalExponents

9.62.1. Function Semantic Definition

This function determines the dimensional exponents of a unit. For named units the dimensions attribute is returned and for derived units the dimensional exponents are calculated from its elements.

Argument definitions:

X: (input) the unit that the dimensional exponents are being derived from.

9.63. Function IfcDimensionsForSiUnit

9.63.1. Function Semantic Definition

The dimensions for SI unit function returns the dimensional exponents of the given SI - unit.

Argument definitions:

N : (input) the name of the unit for which the dimensional exponents will be returned.

10. IfcPropertyResource

The IfcPropertyResource defines a set of basic property object types that can be associated with IFC objects through the IfcPropertySet (defined in the Kernel).

10.1. Select IfcObjectReferenceSelect

10.1.1. Select Semantic Definition

Definition from IAI: IfcObjectReferenceSelect is a select type which enables references to other objects from within property sets.

ISSUES: None.

History

New Select Type in IFC Release 2.0

10.1.2. Select

IfcPerson
IfcOrganization
IfcPersonAndOrganization
IfcClassification
IfcCost
IfcCalendarDate
IfcLocalTime
IfcDateAndTime
IfcDocumentReference
IfcMaterial
IfcMaterialLayer
IfcMaterialLayerSet
IfcMaterialList
IfcMaterialFinish
IfcGloballyUniqueId

10.2. Class IfcEnumeratedProperty

10.2.1. Class Semantic Definition

Definition from IAI: A value selected from an enumeration of defined string values (see IfcEnumeration). This enables applications to include an Enum value in occurrences of IfcPropertySet (defined in the IfcKernel schema).

ISSUES: none to date.

History

New Entity in IFC Release 2.0

10.2.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcProperty
IfcEnumeratedProperty

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	EnumerationIndex	Index into the enumeration pointed to by "Enumeration"	INTEGER	1	see type	1
	EnumerationReference	Enumeration from which a value has been selected by "EnumerationIndex"	IfcEnumeration			

10.2.3. Interface Definitions

- I_EnumeratedProperty

10.3. Class IfcEnumeration

10.3.1. Class Semantic Definition

Definition from IAI: A collection of string values that define a prescribed set of alternatives from which 'enumeration values' are selected. This enables inclusion of Enum values in property sets (defined in the IfcKernel schema). IfcEnumeration provides a name for the Enum as well as a list of STRING values that are defined by the creating application at runtime.

ISSUES: none to date.

History

New Entity in IFC Release 2.0

10.3.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Name	Name of this enumeration	STRING			
	EnumerationValues		LIST [1:?] OF STRING			

10.3.3. Interface Definitions

- I_Enumeration

10.4. Class IfcLibrary

10.4.1. Class Semantic Definition

Definition from IAI: A structured store of information, normally organized in a manner which allows information lookup through an index or reference value. IfcLibrary provides the library name and location (a URL). It also provides optional version, version date and publisher attributes.

ISSUES: none to date.

History

New Entity in IFC Release 2.0

10.4.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Name	Library name	STRING			
OPT	Version	Identifier for reference version	STRING			
	Location	URL location string	STRING			
OPT	Publisher	Library publisher	IfcOrganization			
OPT	VersionDate	Date of the referenced version	IfcCalendarDate			

10.4.3. Interface Definitions

- I_Library

10.5. Class IfcLibraryReference

10.5.1. Class Semantic Definition

Definition from IAI: A reference into a library of information (see IfcLibrary). An optional "ReferencedItem" key is also provided to allow more specific references to library sections or tables.

ISSUES: none to date.

History

New Entity in IFC Release 2.0

10.5.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcProperty
IfcLibraryReference

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	ReferencedLibrary	Library being referenced	IfcLibrary			
OPT	ReferencedItem	Identifier for the referenced item in the library	STRING			

10.5.3. Interface Definitions

- I_LibraryReference

10.6. Class IfcObjectReference

10.6.1. Class Semantic Definition

Definition from IAI: IfcObjectReference allows property level references to other objects through the unique ID associated with that object (IfcGloballyUniqueId). IfcObjectReference enables runtime definition of such references (relationships) between objects. Capture of such relationships is important since not all cross object relationships can be predefined by IAI.

ISSUES: See issue I-252 for background on why it was added.

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

10.6.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcProperty
IfcObjectReference

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	ObjectReference	Reference to another object through one of the types in IfcObjectSelect. The alternatives are other select types and reference by GUID value	IfcObjectReferenceSelect	n/a	n/a	value required

10.6.3. Interface Definitions

- I_ObjectReference

10.7. Class IfcProperty

10.7.1. Class Semantic Definition

Definition from IAI: An abstract generalization for all types of Properties that can be associated with IFC objects through the IfcPropertySet (defined in IfcKernel).

ISSUES: See issue I-080, I-081, GI-002 for background and changes made to this class.

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

10.7.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcProperty
- IfcObjectReference
- IfcSimplePropertyWithUnit
- IfcSimpleProperty
- IfcEnumeratedProperty
- IfcLibraryReference
- IfcPropertyList

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Name	Name for this property	STRING	n/a	n/a	value required
INV	PartOfPropertyList	Reference to the IfcPropertySet, in which the IfcProperty is contained.	SET [0:1] OF IfcPropertyList	n/a	n/a	NIL

10.7.3. Interface Definitions

- I_Property

10.8. Class IfcPropertyList

10.8.1. Class Semantic Definition

Definition from IAI: A list of IfcProperty objects. The included list may be a mixed or consistent collection of IfcProperty subtypes. This allows lists of properties to be included as a single 'property' entry in a property set (see IfcPropertySet in the IfcKernel schema).

ISSUES: none to date.

History

New Entity in IFC Release 2.0

10.8.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcProperty
IfcPropertyList

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
OPT	UserMin	User defined minimum number of list items	INTEGER	0	see type	0
OPT	Max	Maximum number of list items	INTEGER	1	see type	
	Min	Derived minimum number of values in the list. If no user set min, then min is set to 0.	INTEGER			
	HasProperties	LIST of properties that can be used within properties, as referenced by a property set (defined in the Kernel).	LIST [Min:Max] OF IfcProperty	n/a	n/a	NIL

Formal Propositions

WR21	If Max value is spefified, it should be greater than the Min nalue and greater than zero
WR2	The derived Min value shall be greater than or equal to zero.

10.8.3. Interface Definitions

- I_PropertyList

10.9. Class IfcSimpleProperty

10.9.1. Class Semantic Definition

Definition from IAI: IfcSimpleProperty defines a property object, for which a *name -- value* pair is given. It should be used to define simple properties, where the unit is already implied by the type of IfcMeasureValue used and the IfcUnitAssignment defined at the project level (see IfcProject). For simple properties with measures that refer to more specific units, the IfcSimplePropertyWithUnit should be used.

ISSUES: See issue I-080 for changes made in IFC Release 1.5.

10.9.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcProperty
IfcSimpleProperty

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	ValueComponent	Value of this property. NOTE: By virtue of the defined data type, that is selected from the SELECT IfcMeasureValue the appropriate unit can be found within the unit assignment at the IfcProject.	IfcMeasureValue	see type	see type	n/a

10.9.3. Interface Definitions

- I_SimpleProperty

10.10. Class IfcSimplePropertyWithUnit

10.10.1. Class Semantic Definition

Definition from IAI: The IfcSimplePropertyWithUnit defines a property object that has a name, value, unit triplet (occurrence specific unit) using the name inherited from IfcProperty and a ValueWithUnit attribute of type IfcMeasureWithUnit (defined in IfcMeasureResource).

ISSUES: none to date.

10.10.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcProperty
IfcSimplePropertyWithUnit

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	ValueWithUnit	A measure value + a unit defined for this object occurrence.	IfcMeasureWithUnit	see type	see type	n/a

10.10.3. Interface Definitions

- I_SimplePropertyWithUnit

11. IfcRepresentationResource

This schema defines the representation of shape and topology as important definitional properties for products defined within the IFC Object Model. The representations characterize certain properties of a product, and any product can be defined by zero, one, or many of those properties.

The schema defines two ways to represent definitional properties of products:

topological representation
geometric shape representation
The geometric shape representation allows for

multiple shape representations for the same product definition shape of a product
separate shape representations for components or parts of the product definition shape by using shape aspects
The following parts of ISO10303, STEP, had been reviewed to provide input into the specification of the representation resource for the IFC Object Model:

Part 41, Integrated Generic Resources – Fundamental of Product Description and Support
- product_property_definition_schema
- product_property_representation_schema

Part 42, Integrated Generic Resources – Geometric and Topological Representation
- geometry_schema

Part 43, Integrated Generic Resources – Representation Structures
- representation_schema

Please note, that the above listed resources which are defined within Integrated Resources of STEP had been interpreted to fit into the IFC architecture.

11.1. Class IfcGeometricRepresentationContext

11.1.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: A geometric representation context is a representation context in which the geometric representation items are geometrically founded. A geometric representation context is a distinct coordinate space, spatially unrelated to other coordinate spaces.

Definition from IAI: The IfcGeometricRepresentationContext defines the context that applies to several shape representations of a product. It defines the type of the context in which the shape representation is defined, that can be used to describe the level of detailing for which the shape representation is valid (inherited from the supertype), and the numeric precision applicable to the geometric representation items defined in this context.

NOTE: The definition of this class relates to the STEP entity *geometric_representation_context*. Please refer to ISO/IS 10303-42:1994 for the final definition of the formal standard.

ISSUE: No issues raised so far.

History

New Entity in IFC Release 2.0

11.1.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcRepresentationContext
IfcGeometricRepresentationContext

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	CoordinateSpaceDimension	The integer dimension count of the coordinate space modeled in a geometric representation context.	IfcDimensionCount	1	3	3
OPT	Precision	Value of the model precision for geometric models. It is a double value (REAL), typically in 1E-5 to 1E-8 range, that indicates the tolerance under which two given points are still assumed to be identical. The value can be used e.g. to sets the maximum distance from an edge curve to the underlying face surface in brep models.	REAL	see type	see type	0

Formal Propositions

WR21	The rule constrains the supported values of context type for this subtype in this release.

11.1.3. Interface Definitions

- I_GeometricRepresentationContext

11.2. Class IfcProductDefinitionShape

11.2.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: A product definition shape identifies a product's shape as the conceptual idea of the form of a product.

Definition from IAI: The IfcProductDefinitionShape defines all shape relevant information about an IfcProduct. It allows for multiple geometric shape representations of the same product.

HISTORY: The definition of this class relates to the STEP entity *product_definition_shape*. Please refer to ISO/IS 10303-41:1994 for the final definition of the formal standard.

ISSUE: See issues I-041, I-044, I-047, I-048, GI-002, GI-003 for changes made in IFC Release 1.5. See issue I-330 for changes made in IFC Release 1.5.1.

11.2.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcProductRepresentation
IfcProductDefinitionShape

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	ShapeRepresentations	Contained list of shape representations. Each member defining a valid shape representation of a particular type (i.e. bounding box, standard, advance, and arbitrary) within a particular representation context.	LIST [1:?] OF IfcShapeRepresentation	see type	see type	n/a
INV	HasShapeAspects	Reference to the shape representation, explicitly indication aspects or components of the product shape.	SET [0:?] OF IfcShapeAspect	see type	see type	NIL

11.2.3. Interface Definitions

- I_ProductDefinitionShape

11.3. Class IfcProductDefinitionTopology

11.3.1. Class Semantic Definition

Definition from IAI: The IfcProductDefinitionTopology defines the topology of a product. The product definition topology is used for products that are defined within a network. The product definition topology then specifies the connectivity of that product. It does not allow for multiple topological representations of the product, only a single topology can be given.

ISSUE: See I-522 for changes made in IFC Release 2.0.

History

New Entity in IFC Release 2.0

11.3.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcProductRepresentation
IfcProductDefinitionTopology

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	TopologyRepresentation	Contained topology representation representing the topology and connectivity of the product.	IfcTopologyRepresentation	see type	see type	n/a

11.3.3. Interface Definitions

- I_ProductDefinitionTopology

11.4. Class IfcProductRepresentation

11.4.1. Class Semantic Definition

Definition from IAI: The IfcProductRepresentation is a property that defines a property defining a product, including its (geometrical or topological) representation. A product can have zero, one or many of such product representations, and a single product representation can be shared among various products.

NOTE: The definition of this class relates to the STEP entity *property_definition*. The use of the term 'property' was avoided since it conflicts with the property, property type, and property set definitions elsewhere in the IFC Object Model.

ISSUE: No issues raised so far.

History

New Entity in IFC Release 2.0

11.4.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcProductRepresentation
IfcProductDefinitionShape
IfcProductDefinitionTopology

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	GlobalId	Assignment of a globally unique identifier that allows to ensure uniqueness in a global context.	IfcGloballyUniqueId	see type	see type	n/a
	OwnerHistory	Assignment of the information about the	IfcOwnerHistory	see type	see type	n/a

		current ownership of that object, including owning actor, application, local identification and information captured about the recent changes of the object.				
OPT	Name	The word or group of words by which the product definition is known.	STRING	see type	see type	NIL
OPT	Description	The word or group of words that characterize the product definition. It can be used to add additional meaning the the name of the product definition.	STRING	see type	see type	NIL

11.4.3. Interface Definitions

- I_ProductRepresentation

11.5. Class IfcRepresentation

11.5.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: A representation is one or more representation items that are related in a specified representation context as the representation of some concept.

Definition from IAI: The IfcRepresentation defines the general concept of representing product properties.

NOTE: The definition of this class relates to the STEP entity *representation*. Please refer to ISO/IS 10303-43:1994 for the final definition of the formal standard.

ISSUE: No issues raised so far.

History

New Entity in IFC Release 2.0

11.5.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcRepresentation
IfcShapeRepresentation
IfcTopologyRepresentation

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	ContextOfItems	Definition of the representation context for which the different subtypes of representation are valid.	IfcRepresentationContext	see type	see type	n/a
	RepresentationIdentifier	The representation identifier that may provide the primary identification of the representation.	STRING	see type	see type	NIL
	RepresentationType	The description of the type of a representation context. The supported values for context type are specified in a clause for each release.	STRING	see type	see type	NIL

11.5.3. Interface Definitions

- I_Representation

11.6. Class IfcRepresentationContext

11.6.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: A representation context is a context in which a set of representation items are related.

Definition from IAI: The IfcRepresentationContext defines the context to which the representations of product definition shape or product definition topology are related.

NOTE: The definition of this class relates to the STEP entity *representation_context*. Please refer to ISO/IS 10303-43:1994 for the final definition of the formal standard.

ISSUE: See issues I-049, I-051 for changes made in IFC Release 1.5.

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

11.6.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcRepresentationContext
IfcGeometricRepresentationContext

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	GlobalId	Assignment of a globally unique identifier that allows to ensure uniqueness in a global context.	IfcGloballyUniqueId	see type	see type	n/a
	ContextIdentifier	The identifier of the representation context as used within a project.	STRING	see type	see type	n/a
	ContextType	The description of the type of a representation context. The supported values for context type are specified in a clause for each release.	STRING	see type	see type	n/a
INV	RepresentationsInContext	All shape representations that are defined in the same representation context.	SET [1:?] OF IfcRepresentation	see type	see type	n/a

11.6.3. Interface Definitions

- I_RepresentationContext

11.7. Class IfcShapeAspect

11.7.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: The shape aspect is an identifiable element of the shape of a product.

Definition from IAI: The IfcShapeAspect allows for grouping of shape representation items that represent aspects (or components) of the shape of a product. Thereby shape representations of components of the product shape representing a distinctive part of a product that can be explicitly addressed.

NOTE: The definition of this class relates to the STEP entity *shape_aspect*. Please refer to ISO/IS 10303-41:1994 for the final definition of the formal standard.

ISSUE: See issues I-330 for changes made in IFC Release 1.5.1.

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

11.7.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	GlobalId	Assignment of a globally unique identifier that allows to ensure uniqueness in a global context.	IfcGloballyUniqueId	see type	see type	n/a
	ShapeRepresentations	Contained list of shape representations. Each member defining a valid shape representation of a particular type (i.e. bounding box, attribute driven, explicit) within a particular representation context.	LIST [1:?] OF IfcShapeRepresentation	see type	see type	n/a
OPT	Name	The word or group of words by which the shape_aspect is known. It is a tag to indicate the particular semantic of a component within the product definition shape, used to provide meaning. Example: use the tag "Glazing" to define which component of a window shape defines the glazing area.	STRING	see type	see type	n/a
OPT	Description	The word or group of words that characterize the shape_aspect. It can be used to add additional meaning the the name of the aspect.	STRING	see type	see type	n/a
	ProductDefinitional	An indication that the shape aspect is on the physical boundary of the product_definition_shape. If the value of this attribute is TRUE, it shall be asserted that the shape_aspect being identified is on such a boundary. If the value is FALSE, it shall be asserted that the shape_aspect being identified is not	LOGICAL	FALSE	TRUE	UNKNOWN

		on such a boundary. If the value is UNKNOWN, it shall be asserted that it is not known whether or not the shape_aspect being identified is on such a boundary. EXAMPLE: Would be FALSE for a center line, identified as shape aspect, would be TRUE for a cantilever.				
	PartOfProductDefinitionShape	Reference to the product definition shape of which this class is an aspect.	IfcProductDefinitionShape	see type	see type	n/a

11.7.3. Interface Definitions

- I_ShapeAspect

11.8. Class IfcShapeRepresentation

11.8.1. Class Semantic Definition

Definition from ISO/CD 10303-42:1992: The shape representation is a specific kind of representation that represents a shape.

Definition from IAI: The IfcShapeRepresentation represents the concept of a particular geometric representation of a product or a product component within a special geometric representation context.

NOTE: The definition of this class relates to the STEP entity *shape_representation*. Please refer to ISO/IS 10303-41:1994 for the final definition of the formal standard.

ISSUE: See issues I-043, I-052, I-184, I-194 for changes made in IFC Release 1.5.

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

11.8.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcRepresentation
IfcShapeRepresentation

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Items	Set of geometric representation items that are defined for this representation	SET [1:?] OF IfcGeometricRepresentationItem	see type	see type	n/a
INV	OfProductDefinitionShape	Reference to the product shape, for which it is the shape representation	SET [0:1] OF IfcProductDefinitionShape	see type	see type	n/a
INV	OfShapeAspect	Reference to the shape aspect, for which it is the shape representation	SET [0:1] OF IfcShapeAspect	see type	see type	NIL

Formal Propositions

WR22	The IfcShapeRepresentation shall be either defined for a single product shape or for a single shape aspect.

WR23	The context to which the IfcShapeRepresentation is assign, shall be of type IfcGeometricRepresentationContext.
WR24	The rule constrains the supported values of representation type for this subtype in this release.
WR25	Constrains the valid Items for representation according to the Shape Representation Type (IfcShapeRepTypeEnum) BoundingBox

11.8.3. Interface Definitions

- I_ShapeRepresentation

11.9. Class IfcTopologyRepresentation

11.9.1. Class Semantic Definition

Definition from IAI: The IfcTopologyRepresentation represents all topologically relevant information about an product, including its connectivity.

ISSUE: See I-522 for changes made in IFC Release 2.0.

History

New Entity in IFC Release 2.0

11.9.2. Attribute and Relationship Definitions

Superclasses and Subclasses

IfcRepresentation
IfcTopologyRepresentation

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	Items	Set of topological representation items that are defined for this representation.	SET [1:?] OF IfcTopologicalRepresentationItem	see type	see type	n/a
INV	OfProductDefinitionTopology	Reference to the product definition topology, for which it is the topological representation	IfcProductDefinitionTopology	see type	see type	n/a

11.9.3. Interface Definitions

- I_TopologyRepresentation

12. IfcUtilityResource

The resource schema IfcUtilityResource deals with general concepts – Identification, Ownership and History. It also includes a basic information construct – Tables. The classes of this schema are referenced throughout the whole IFC Object Model by all of its Model Layers as defined in the IFC Architecture Document. The IfcUtilityResource schema consequently contains model specifications for specifying the information content of a number of utility types.

The various types of registries were removed from this schema in Release 2.0 since the method used within applications to store those types of information could differ between different applications.

This schema contains the following concepts:

1. Identifier
2. Ownership
3. History
4. Table

Identifier

The identifier allows IFC classes to be uniquely identified within the scope of the whole software world. Classes that do not have independent existence, i.e. that are contained by other classes, do not have an independent identifier - their uniqueness is provided by the container class.

Ownership

Each object, relationship and type definition will provide information about their current ownership. Ownership information is the currently "owning" application and the owning (responsible) actor. This ownership information can be used for access and change permissions. Ownership can be transferred from one person to another through the life cycle of a project.

Note: the specification of access rights is not described in this IFC release.

History

The history of an IFC object is captured as an audit trail, where only the fact that a modification or transaction is kept, not the modification itself. For each modification, including the creation and deletion, a triple of date, user and application is stored.

Table

The specification of table is general purpose and may be used for any two dimensional matrix type document. It allows information to be recorded in rows and columns where each column is labeled with the type of information it contains. The model does not allow for any mathematical operations on the information content of a table (i.e. it does not function as a spreadsheet).

12.1. Type IfcGloballyUniqueId

12.1.1. Type Semantic Definition

Holds an identifier that is unique throughout the software world. This is also known as a Universal Unique Identifier by the Open Group. The identifier is generated using an algorithm published by the Object Management Group based on the IP address of the computer than generates the identifier. The algorithm is explained at http://www.opengroup.org/dce/info/draft-leach-uuids-guids-01.txt. The document as it exists on 13 March 1999 is included in the Development Guide as an appendix. In Release 1.5 the Microsoft Foundation Class function "CoCreateGuid" was used. The MFC function is an implementation of the above algorithm.

The identifier resulting from the application of the GUID algorithm is then compressed into 20 characters using an algorithm developed by Peter Muigg which maps the GUID bits onto a base 84 digit encoded from the following character set : "0123456789ABCDEFGHIJKLMNOPQRSTUV WXYZabcdefghijklmnopqrstuvwxyz!#$%&^|*+,-./:;<=>?~`@_". The index in this string determines the "value" for each character (0-84), e.g. "A" has a value of 10, "@" has a value of 83. Please note: the characters are case-sensitive! This is also explained in the Development Guide.

NOTE : IfcProjectUniqueID from R1.5 is no longer used.

12.1.2. Type

STRING(20) FIXED

12.2. Type IfcModifiedFlag

12.2.1. Type Semantic Definition

This flag is used to notify an application that is reading data about the state of dependent information. The bits considered in sequence define the following states:

First bit	Full Read/Write Access to unchanged object
Second bit	Dirty (contents of object have been changed by “somebody”)
Third bit	Object is Read Only
Fourth bit	Object is Locked. This allows a repository server to mark an object as being unavailable either because 1) its contents have been checked out to another process, 2) a commit is in process, etc.

Consequently, the following states can be given using bitwise operations under an octal numbering system:

0 = Clean read/write
1 = Dirty read/write
2 = Read Only
3 = Dirty read only
4 = Locked
5 = Dirty locked
6 = Locked Read only
7 = Dirty Locked Read only

Further explanation of this capability is given in Volume 2 of the IFC Specifications.

History

New Defined Type in IFC Release 2.0

12.2.2. Type

BINARY(3) FIXED

12.3. Class IfcApplication

12.3.1. Class Semantic Definition

The IfcApplication is an IFC compliant application developed by an application developer who is a member of the International Alliance of Interoperability. The IfcApplication gets an unique identification within the IFC development framework.

NOTE Added in IFC Release 1.5 .

ISSUE See issues I-003 for changes made in 1.5 final release. This object was called IfcRegistered Application in Release 1.5.1

12.3.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	ApplicationIdentifier	Short, max. 16 character long identifying short name for the application, being registered and known to the IAI conformance program.	STRING(16)	see type	see type	n/a
	ApplicationFullName	The full name of the application as specified by the application developer.	STRING(255)	see type	see type	n/a
	Version	The version number of this software as specified by the developer of the application.	STRING(255)			
	ApplicationDeveloper	name of the application developer, being requested to be member of the IAI.	IfcOrganization	see type	see type	n/a

Unique Rules

UR1	Ensure that there are no duplications of application instances with the same registered identifier.
UR2	The combination of application name and version shall be unique.

12.3.3. Interface Definitions

- I_Application

12.4. Class IfcAuditTrail

12.4.1. Class Semantic Definition

The *IfcAuditTrail* maintains a limited history for an object instance. Currently, this history records the person responsible for and the application used to create, delete and modify objects. The deletion of an object is also captured as an object will most likely be marked as deleted, but not actually removed from the model file. This will facilitate “roll back” functionality in future releases of IFC.

NOTE This class is a revised version of the IFC Release 1.0 class IfcExtendedId.

ISSUE See issue I-004, I-215, I-216 for changes made in 1.5 final release. The WHERE rule which limited the audit trail length to one operation was removed in IFC Release 2.0.

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

12.4.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	CreationDate	Date on which object was created	IfcTimeStamp	see type	see type	n/a
OPT	DeletionDate	Date this object was deleted from the model - NOTE: an deleted Object still needs to be communicated.	IfcTimeStamp	see type	see type	n/a
	CreatingUser	End User who created this object. The	IfcPersonAndOrganization	1	see type	1

		integer defines a pointer into the IfcProjectTeamRegistry.				
OPT	DeletingUser	End User who deleted this object from the model. The integer defines a pointer into the IfcProjectTeamRegistry.	IfcPersonAndOrganization	1	see type	1
	CreatingApplication	Application used to create this object. The integer defines a pointer into the IfcProjectAppRegistry.	IfcApplication	1	see type	1
OPT	DeletingApplication	Application that deleted this object from the model. The integer defines a pointer into the IfcProjectAppRegistry.	IfcApplication	1	see type	1
	Transactions	Stored last transactions that affected the object. Currently only the last transaction is kept	LIST [0:?] OF IfcTransaction	0	AuditTrail Length	0
INV	ToOwnerHistory	Reference to the IfcOwnerHistory in which the IfcAuditTrail is defined (and contained).	IfcOwnerHistory	see type	see type	n/a

12.4.3. Interface Definitions

- I_AuditTrail

12.5. Class IfcOwnerHistory

12.5.1. Class Semantic Definition

The IfcOwnerHistory defines all history and identification related information. In order to provide fast access it is directly attached to all independent objects, relationships and properties.

The IfcOwnerHistory is used to identify the creating and owning application and user for the associated object. An optional description can also be provided by the owner. A reference to the audit trail of the object is also provided.

NOTE This class is a revised version of the IFC Release 1.0 class IfcOwnerId .

ISSUE See issues I-001, I-002 and I-003 for changes made in 1.5 final release.

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

12.5.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	OwningUser	Direct reference to the end user who currently "owns" this object. Note that IFC includes the concept of ownership transfer from one user to another and therefore distinguishes between the Owning User and Creating User.	IfcPersonAndOrganization	1	see type	1

	OwningApplication	Direct reference to the application which currently "Owns" this object on behalf of the owning user, who uses this application. Note that IFC includes the concept of ownership transfer from one app to another and therefore distinguishes between the Owning Application and Creating Application.	IfcApplication	1	see type	1
	ModifiedFlag	Three bits that define the current state of the object. 0 indictes that the object is safe for that aspect (not yet final)	IfcModifiedFlag	%000	%111	%000
OPT	ApplicationId	Internal ID used by the Owning Application.	STRING	see type	see type	NIL
OPT	OwnerDescriptor	User or application descriptor for this object. This might be the user descriptor like "Molly's Room", or description of intended use like "Barge board for south facade siding", etc.	STRING	see type	see type	NIL
OPT	AuditTrail	Reference to the history related information, if given, it shows the latest transaction that leaded to modifications at the object.	IfcAuditTrail	see type	see type	NIL

12.5.3. Interface Definitions

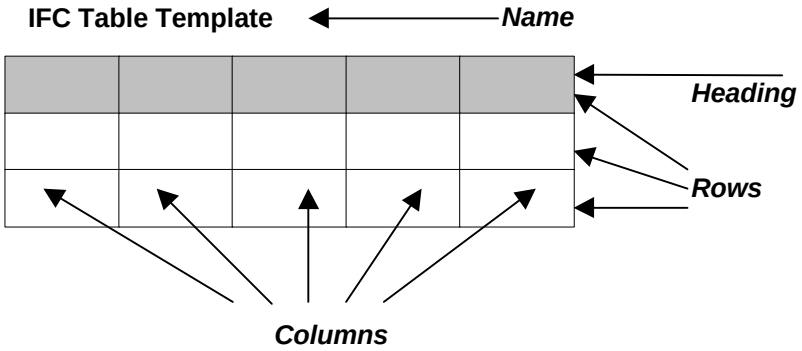
- I_OwnerHistory

12.6. Class IfcTable

12.6.1. Class Semantic Definition

A data structure for the provision of information in the form of rows and columns. Each instance may have a heading row, with titles or descriptions for each column. The rows of information are stored as a list of IfcTableRows.

Limitation: In this release of IFC the Rows of an IfcTable object are constrained to have the same number of Cells. The first Row of the Table provides the number of Cells. All other Rows are forced to include the same number of Cells. This is enforced by the WR2.



History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

12.6.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	GlobalId	Assignment of an unique identifier within the project that allows to ensure uniqueness in a project context.	IfcGloballyUniqueId	see type	see type	n/a
	Name	A unique name which is intended to describe the usage of the Table.	STRING	see type	see type	n/a
	Rows	Reference to information content of rows.	LIST [1:?] OF IfcTableRow	1	N	2
	NumberOfCellsInRow	The number of cells in each row, this complies to the number of columns in a table. See WR2 that ensures that each row has the same number of cells. The actual value is derived from the first member of the Rows list.	INTEGER	1	see type	2
	NumberOfHeadings	The number of headings in a table. This is restricted by WR3 to max. one.	INTEGER	0	1	1
	NumberOfDataRows	The number of rows in a table that contains data, i.e. total number of rows minus number of heading rows in table	INTEGER	1	see type	2

Formal Propositions

WR1	Ensures that each row defines the same number of cells. This restricts the available table styles in IFC Release 1.5. The rule compares whether all other rows of the IfcTable have the same number of cells as the first row. EXPRESS = SIZEOF(QUERY(Temp
WR2	Ensures that each row defines the same number of cells. This restricts the available table styles in IFC Release 1.5. The rule compares whether all other rows of the IfcTable have the same number of cells as the first row. EXPRESS = SIZEOF(QUERY(Temp
WR3	Ensures that there is one heading row as maximum. This restricts the allowed number of heading rows for this release. This limitation may be removed in future releases. EXPRESS = 0 <= NumberOfHeadings <= 1 }

12.6.3. Interface Definitions

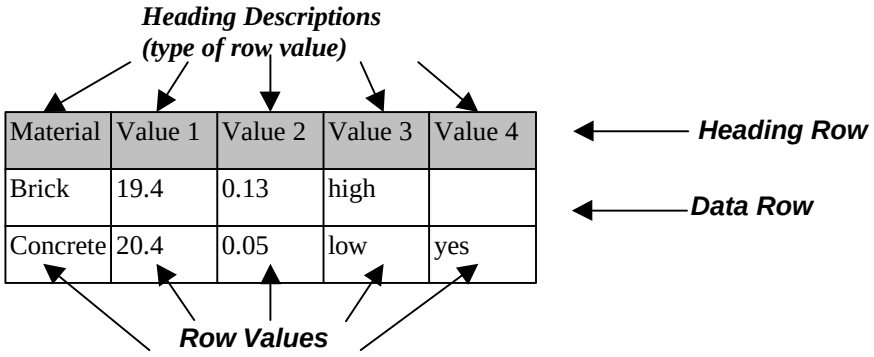
- I_Table

12.7. Class IfcTableRow

12.7.1. Class Semantic Definition

The information content of each row within the table (other than the heading row). A table contains a number of rows which record information concerning the instance of the type of information recorded within the table.

Limitation: There is the restriction within this release of IFC. All IfcTableRow objects referenced by an IfcTable shall have the same number of Row Cells. The actual number of Cells shall be taken from the number of cells of the first IfcTableRow for that table. The number of Cells is calculated by the derived attribute NumberOfCellsInRow in the associated IfcTable.



NOTE Added in IFC Release 1.5

ISSUE See issues I-153, I-218, I-219, I-220, I-221, I-222 for changes made in 1.5 final release

12.7.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	RowCells	The value of information by row and column using the units defined. NOTE - The row value identifies both the actual value and the units in which it is recorded. Each cell (unique row and column) may have a different value AND different units. If the row is a heading row, then the row values are strings defined by the IfcString.	LIST [1:?] OF IfcMeasureValue	1	see type	2
	IsHeading	Flag which identifies if the row is a heading row or a row which contains row values. NOTE - If the row is a heading, the flag takes the value = TRUE.	BOOLEAN	see type	see type	FALSE
INV	OfTable	Reference to the IfcTable, in which the IfcTableRow is defined (or contained)	IfcTable	see type	see type	n/a

12.7.3. Interface Definitions

- I_TableRow

12.8. Class IfcTransaction

12.8.1. Class Semantic Definition

IfcTransaction currently captures the date, the application and the user who made a change. The change itself is not captured.

NOTE Added in IFC Release 1.5.

ISSUE See issues I-004 for changes made in 1.5 final release.

History

This Entity has changed after IFC Release 1.5.1, please see the Migration Guide for details

12.8.2. Attribute and Relationship Definitions

Superclasses and Subclasses

This Class does not have any Superclasses or Subclasses

Attributes and Relationships

	Attribute / Relation	Definition	Data or Rel. Type	Min.	Max.	Default
	TransactionDate	Date and Time at which the transaction occurred.	IfcTimeStamp	see type	see type	n/a
	TransactingUser	User who carried out the transaction.	IfcPersonAndOrganization	1	see type	1
	TransactingApplication	Application being used to carry out the transaction.	IfcApplication	1	see type	1
INV	ToAuditTrail	Reference to the IfcAuditTrail in which context the transaction is captured	IfcAuditTrail	see type	see type	n/a

12.8.3. Interface Definitions

- I_Transaction